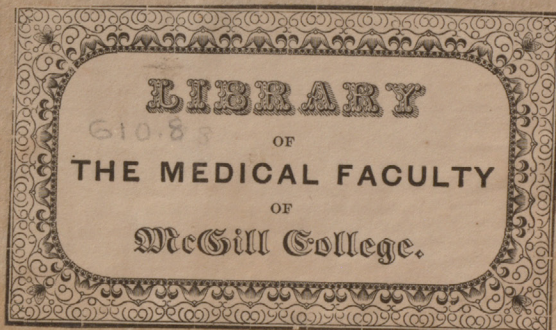
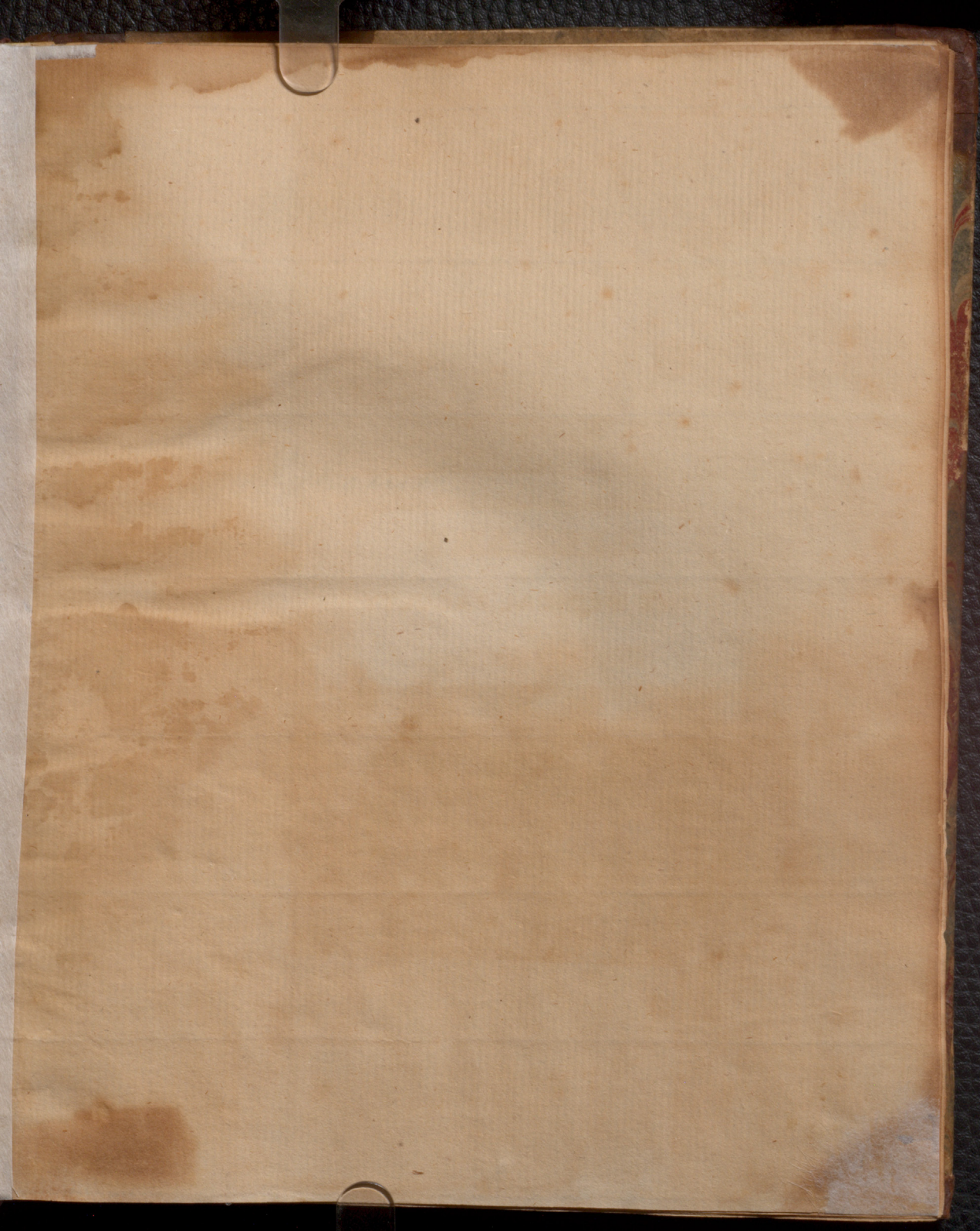


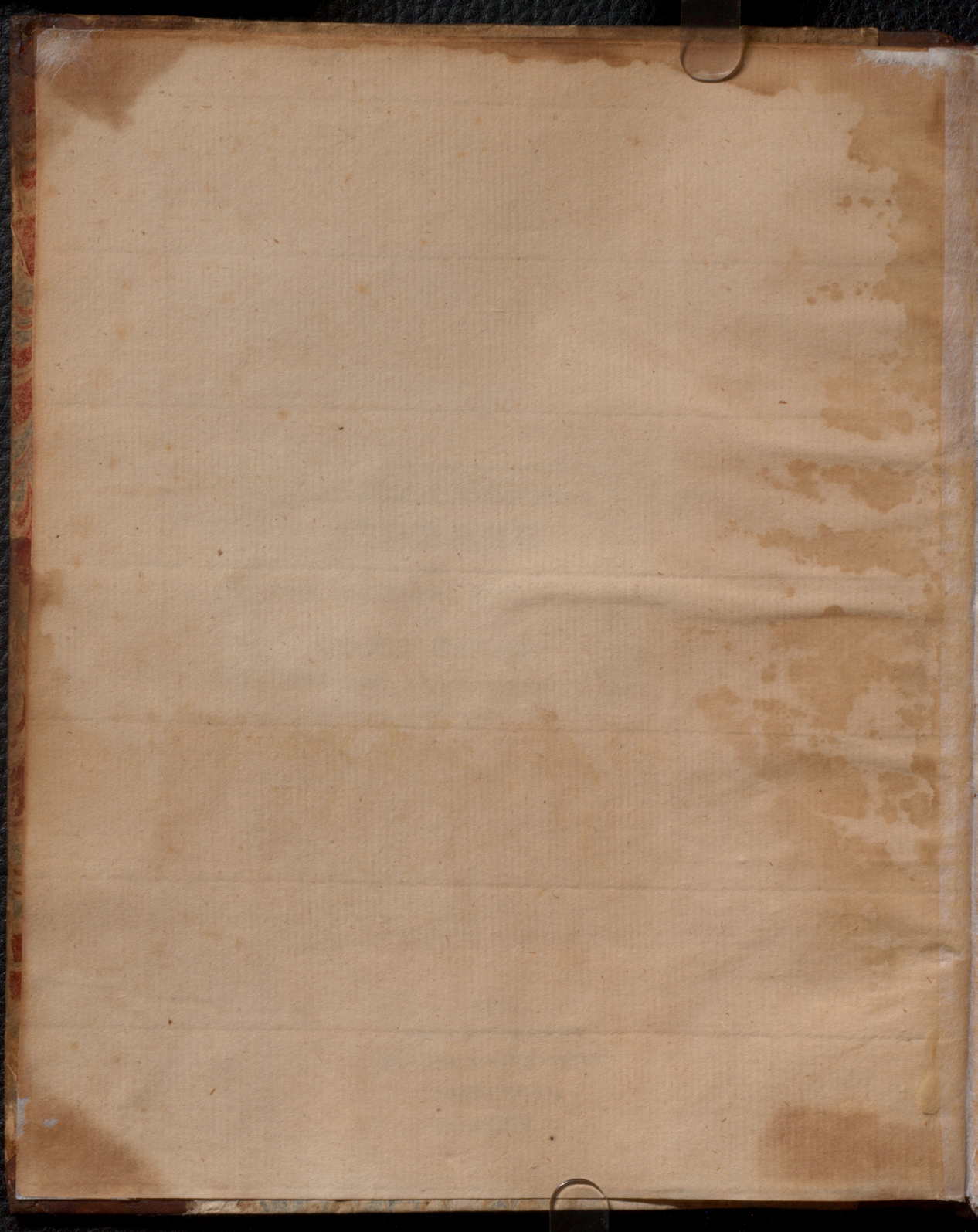




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Anatomical Lectures

By

Doctor Alexander Monro

Professor of Anatomy and The Practice
of Physic in the College of Edinburgh —

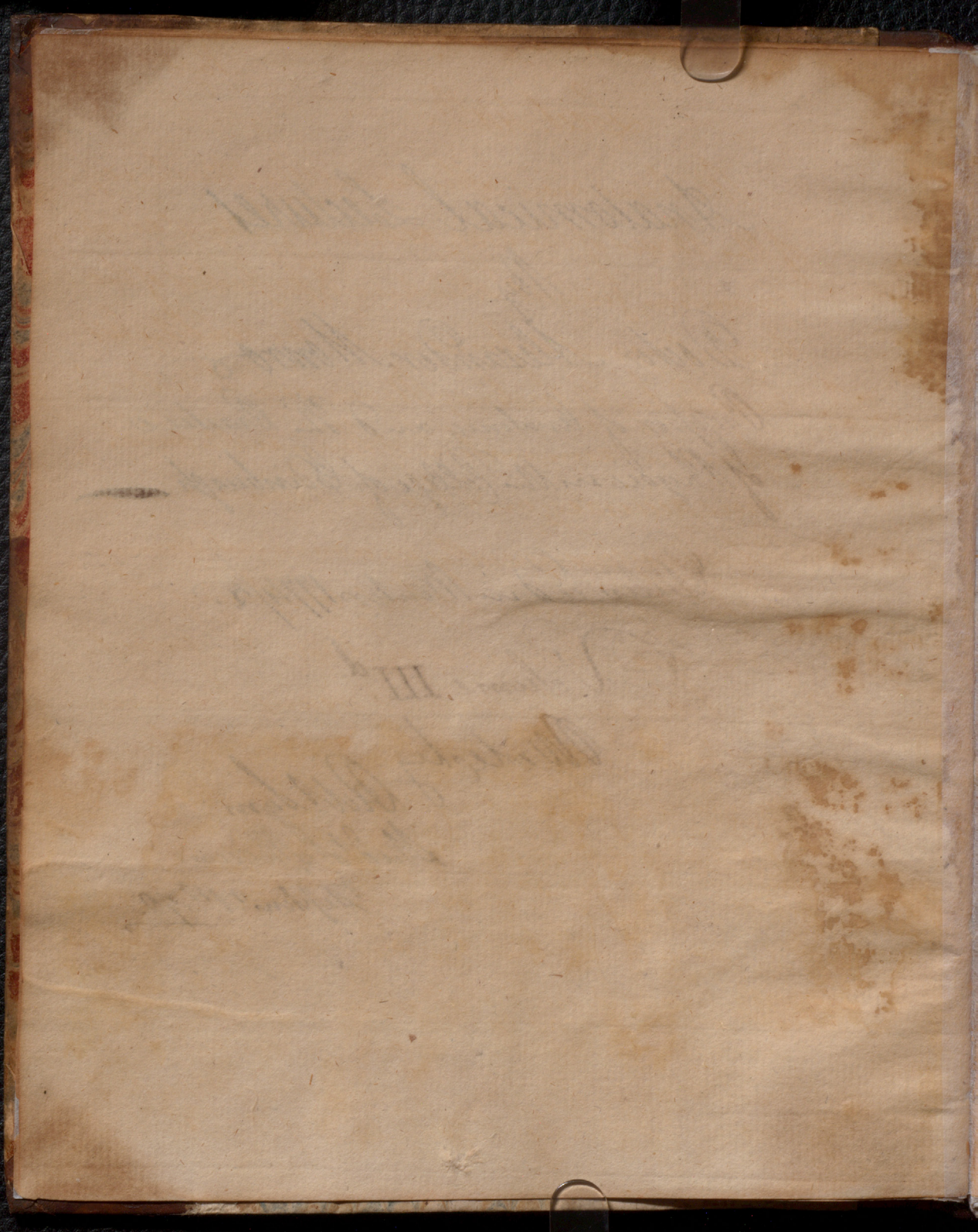
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Volume III.^d

Written by Rob^t Sym

M.D. of Medicine

Septem^r 1770.



Sect. 44th

We have now after seeing the Structure, of the Basis of the body, examined fully its situation, connection, general Structure & Properties of the several organs so far as could be readily discovered by Dissection. We are now to enter upon the examination of them with much more accuracy and to view them in a more extensive, consequently in a more entertaining light, viz, as several parts conspiring to form one Machine or System. The connection between the several organs has been hitherto concealed from us, because we purposely avoided to trace the Vascular & Nervous Systems, not that this merely would have led us at once into too wide a field, but because we were by no means sufficiently prepared for such an enquiry. For without knowing the bones muscles &c. we wanted an outline by which we could describe the situation of the vessels and

and Nerves. Just as when a person describes the course of a river, he must first be acquainted with the situation of the ground thro which it passes. Next, we avoided entering with accuracy upon the structure & the function of each organ, because these in a great measure depend upon the blood vessels & Nerves; or the variety to be observed in the several organs is in a great measure owing to the modification of the Vascular & Nervous Systems tho not entirely so. Hence before the functions can be fully discussed, we are under a necessity of not only pursuing the larger branches of the blood vessels & Nerves, but till we trace them to their termination and till the functions are understood we can't attempt to explain the changes that are produced by disease.

If you look into the most common systems in your hands, as that of Wensler, you will find this to be true. Trust after y^e Heart
it

is supposed, the arteries are traced in a 526.
particular section, that is followed by an
account of the Venous system; and had Winslow
been acquainted wth the Lymphatic system,
that would have followed in its proper order;
and lastly the Nerves are described. And this
method has been often followed by Anatomists
and seems at first sight eligible from its Dis-
tinctness; but reflecting a little we shall
find Abundant reasons for following a diff^t
method. For before we have finished the
one system, the particular parts w^{ch} which
we began are in a great measure forgot, and
the situation of the veins with respect to the
arteries cannot be fully understood.
I apprehend therefore that our view of the
Structure of any particular member will
be more distinct, if after we shew ye arteries
we immediately shew the veins corresponding
with them or also the Lymphatics and
the Nerves. And there is a wonderfull re=
re=

524. Resemblance, not only of the Distribution of
the arteries & Circulating veins, but in the
Afferent vessels and the Nerves, so that if
We enumerate the principle branches of any
Artery, we are led at the same time to
enumerate a ~~Corresponding~~ corresponding vein, Lymphatics
and Nerves; and taking them thus together
We not only render the Study much shorter
by avoiding needless repetition, but we observe
the relative situations of these systems which
is of infinite service. Besides if we follow
the sev^l vessels & Nerves separately, when We
are to attempt to explain the structure & funct-
= use of any organ, suppose of the Liver, if I
begin with the arteries, then take the properties
of that organ, You cannot understand them;
if I again delay this till the Nerves have
been demonstrated, You have forgot in a
great measure the Distribⁿ of the Vessels.
I am therefore to beg before You the most
mat=

material circumstances relative to the 518.
structure of any part, at one view; and this
I can do without deviating from method,
by pursuing the following plan.

Before we engage in the prosecution of any
one of the four systems, we shall study the
gen^l properties suited by each; then we begin
with the dissection of the particular branches,
first following the Aorta. Tracing this upwards
we shall find that the first branches lead
directly to the head, then to the Brain and
Cerebellum, or to the origin of the Nerves; so
we are led to follow the Nerves and Vessels
in the same order we would have taken
supposing we had pursued either system
separately. for the next vessels in a separate
enquiry would be those on the side of the
head, and if we had been to trace the Nerves
alone, we wd have taken those of the head,
The Olfactory, The Optic &c. And having
thus

529. Thus traced the vessels Envelopes of all the
softer parts of the Body, we end our enquiries
with the structure of the Basis, of the Bones
in general & the parts connected with them,
and of the Teeth as a particular part of the
Basis.

We now proceed to the execution of our
plan; and beginning with the Heart as the
Prime Mover, I propose at this meeting to
demonstrate some circumstances w^{ch} regard
to that organ, then to demonstrate the
gen^l structure of the Coat of a vascular system;
The circumstances of the shape of arteries,
Their dividing into Branches &c. and we
shall observe nearly the same things with
respect to the veins. Then I shall show
the appearances produced in the Circulat^y
System by Disease.

We considered the structure of the heart
before, as a Muscular organ covered by
Mem^{br}

Membranes, and pushing the blood thro' it
 into Vessels; I now add the view of Cavities
 of the Heart filled with Wax, where you observe
 the real Depth of the Ventricles, and that the
 Left Ventricle really descends somewhat lower
 than the Right, but not much. The shape of
 the two sides is essentially different, the
 Right being flatter than the Left, and yet
 Left Ventricle seems thicker than the Right.
 Next, observe that the Ventricle on both is
 larger than the Atricle with the Sinus.
 Lastly, the right side of the Heart is larger
 than the Left, but the difference is not so
 great as it appears, from the Left not yield-
 ing so readily to the force of the Injection. Haller
 has committed a mistake of Malpighi's with
 regard to the appearance of the coronary
 arteries in the Chick, that they are not
 originally at a distance, but come off
 from the Aorta behind its Valves. We see
 also

also a fallacy in Boerhaave's account of the alternate action of the Heart, from principles branches of the Arteries running in about the Trunks of the great arteries, & being compressed by them, for we find many branches sent off to the Heart, which do not come near to the Arteries. As the Semilunar valves the Arteries are not circular, but are composed of three segments of a circle, or there are ~~valves~~ bays behind the Valves into which the blood enters in order to shut them. These have been called Sinuses by Balsalva, and they are to be found in the mouth of the Pulmonary artery as well as in that of the Aorta, and this swelling is not the mere effect of use, but is an original structure.

Next examine the structure of the Arteries & Veins. - The outside of an artery appears of a half opaque colour, and on the

592.

The surface we find threads like these
of cotton, which connect it to the neighbour
parts, & going deeper we find these threads
of cellular substance matted together &
forming this opaque coat; or we find a
coat made of the cellular substance com-
-densed so as to put on the appearance of
a Membrane, therefore we shall call
this coat Membranous. When that
is removed, we find within it fibres laid
transversely or circularly, & these constantly
of a pale red colour, paler than y^e flesh
to which they belong; just as the fibres
of the elementary canal are paler than
the External muscles. Perhaps not one
of these describe a complete circle, but taking
the gen^l disposition they are called very
properly Circular. They are connected to
each other by cellular membranes, so
that air blown under the outermost Cellu-
mem-

membranous coat, passes into their
 intestines. Then we find within this
 coat a very thin transparent one, not
 unlike the thin skin which lines the
 shell of an egg, may indeed it is not by
 any means tough, but is very where ex-
 =tremely close or dense, so that liquors don't
 easily pass thro' it. This is the innermost
 smooth coat of an artery; there is no manner
 of reason for applying the term Villous tact;
 and these three coats are tied by the common
 cellular substance, which is as much between
 the fibrous coat, & the Intima, as between
 the Membranous & Muscular, but the
 threads are smaller, and between these
 last there is never fat deposited, the coat
 is merely cellular without being adipose.
 In some of the larger Arteries the cellular
 coat may be split into a number of diff't
 layers, so I have seen divided the fibrous
 coat

Coat of the Arteries into 2 different layers, 534.
but you are to conceive them to be one.

Next, Let us examine the coats of veins.
In a smaller vein the coats are so thin and
transparent that we find it very difficult
to separate them, but going nearer the Heart
the separation is made more easily. Near
the Heart the Vena Cava comes to partake of
the structure of the Arterie, we see the fibres
distinctly, and the motion is evident in a
living animal. But taking the Vena
Cava inferior below this part, we find a
Membranous coat composed of cellular
membrane condensed. Within that
we see a reddish coloured coat, in which
we distinguish longitudinal as well as
transverse fibres, but both very fine, &
not laid in such loose bundles as in the
Arteries, so that from the smallness and
the closeness with which they are joined
they

535. They have left the appearance of a muscle.
Then we find the Intimal coat as in the
Artery, but with this difference, That in ye
vein it is joined to the outer coat by a much
looser cellular substance, and it is more
Elastic & stronger, it does not tear so easily,
and upon stretching it, it draws in with
considerable force. So the Elasticity of the
Veins depends on their inner coat chiefly,
whereas in the Arteries that seems to
depend upon their coat. Next, The veins
have valves in them, formed of their
inner Membrane doubled, we find two
Valves together, each of which describe a
circle, so that they shut themselves
perfectly. I shall next describe in a general way
some diseased appearances of the Heart
and Arteries —
1st The Pericardium every where adhering
to the body of the Heart.

2^d A complete ossification, or a strong matter
in the Valves of the Aorta; & only a small
hole left for the passage of the blood. The
Heart at the same time a great deal larger
than natural, & double the usual weight.

3^d Ossification extended into the Aortae, &
in such cases sent Polypos in the Heart.

4th A Dilatation between the Heart and
the arch of the Aorta; also a large hole lead-
ing to a bag or sac, which sprung out of the Aorta;
and in the Trachea itself a small hole
by which the Patient used to cough up
blood before his Death.

5th Ossifications extending along the Coronary
Aortae, the Venae, the Heart at the same
time. This Person dyed in a Moment
after slight complaints in the breast.

6th We find the parts of the Heart and
Aortae burst, as the Aorta, Venae,
The

537. The Septum between the Ventricles, a dissep-
-tion about this Septum and a considerable
quantity of Pus found, the Patient lab-
ours under Pneumonic complaints.

7th Dilatation & Ruptures of the Arteries
in the Cavities Abdominalis, and in the
Peritoneal Cavity.

Lect. 45th

We now proceed to trace the blood in its
Course, & to observe some further genl. circumstances
with regard to the Arteries & Veins.

When we look at the Arteries in a superficial
manner, Their shape appears conical just as
looking at ye trunk of a tree we conceive
it to be a cone. But examining either with
attention, That appearance is produced by
the Branches set off, or look at any Artery
running a considerable way without
giving off Branches, & you will be immed-
-ately convinced that it is cylindrical.

The

The next circumstance which very strikingly
 one is, That if all these Branches running
 to our Diff. Members were cut out and
 Join'd together into one Cylinder, the Bulk
 would much exceed the Quantity of y^e Cortex.
 It is difficult to determine the proportions
 of the enlargement, which seems to vary in
 different organs, But upon the whole I
 apprehend that Authors have fix'd a
 tolerable Medium in supposing That
 where an Artery, as the Cortex at y^e bottom
 of the Abdomen, divides into two Branches,
 the proportion of these compared with y^e
 Trunk is nearly as 3 to 2, or they are
 nearly $\frac{1}{2}$ wider. Now as these divisions
 are very frequently repeated, the capacity
 of the Arteries must be continually decreasing
 as we proceed outwards from the Heart
 so instead of considering them as conical
 with

539. with the large end joined at the Heart, you
are rather to invert the cone, & turn y^e small
end towards the Heart. Kind, observe the
Angles the Arteries make. The greater number
run in the most favourable direction to
their organs &c Most of the Angles are
acute; but in some places a Branch comes
off nearly at a right angle, and in a few
other places the Angle is more than Right,
or the Artery seems as it were retrograde.

It is very plain that the nearer to the direction
of the Trunk the branches are set off, the greater
will be the force of the blood, so the angle at
which the greater number is sent off is acute.
But on this account where similar organs
such as Muscles need to be supplied near to
the Heart, and at a distance from it, Nature
endeavours to make the force of the blood
near to the Heart, that the flow may be
fully equal in all, by sending in the
blood

Blood at greater angles, & by being by smaller Branches, the sides of which make more resistance than is made by the sides of a great Muscle. This appears when we compare the intercostal muscles, with the more distant Muscles of the Extremities.

The next thing we attend to is, That the Arteries in their course meeting with many Resistances from a variety of circumstances; from the situation of parts, the posture made, the action of Muscles, the posture into which we put ourselves &c. There is a necessity of guarding against obstructions. Hence we find that there are veins, where communications, or what Anatomists call Anastomosis, exist in the Arterial System, between small Branches only, but in some few places, as in the Mesentery, which may be looked upon as the Branches changing their place, we observe large

541. Large arches formed, that if one branch be
stopped, the blood may run up the other
side at its opposite side. Near to likewise
to observe the extreme divisions which the
Arteries form, as on the Villous coat of the
Intestines, where we only observe a general
redness with the naked eye. Nor can we
expect with the naked eye to see, Divisions
which are made, if we attend to, especially
we are under in looking at the motion of the
blood to use the Microscope, by which we
discover that Three or Four Thousand Arteries
said parallel ^{to one another} for each other, would not exceed
in breadth a single inch, or that a hair of the
Head is equal to 3 or 4 Thousand of these
ultimate branches which convey red blood.

From the extremities of the Arteries the
Veins are reflected and return the blood to
the Heart, very much in their course, resembling
what

what has been shown in the Arteries. 342.

In their course they are continually joining
into Trunks, or becoming larger, till at last few
Two trunk veins are formed. But in many
places of the body, male that are Muscular,
where the Veins are exposed to aduse organs,
We find within them Valves, or Blood gates,
which serve to obdurate the blood to the
Heart in whatever way the vein is affected
by the pressure of the Muscle. Nor is this
continuance alone sufficient, but we find
that where there are Valves, there are
more veins than Arteries, as in 4th Members
of the body, where we find one set accompany
the Artery very closely, while another set
runs under the Skin, as free from the
action of Muscles as possible, & these have
various communications.

Now so far I have settled the merg^d Data
for

543. For understanding the Circulation of the blood.
I have but one kind of paper to show for ex-
plaining one use which Circulation serves,
it is a Cracked which I cut out, from which
there are innumerable vessels &c. In y^e case
of wounds & loss of substance, we not only
find new vessels formed, but those on opposite
sides of an wound come to anastomose, a fact
which is extremely curious, & w^{ch} will appear
the more so the longer we consider it. For
when we have made a wound, we readily
conceive that the mouths of the arteries
may be elongated. but how is the blood
from these returned to the heart? How are
corresponding veins formed? How do these
join with elongated Arteries? And How do
the Arteries on the opposite sides meet so
accurately, as to make them continued Canals?
We

We see however that this actually happens. It is scarcely worth while to add a proof of the liquors passing from the extremity of an Artery into the beginning of a Vein, having explained the circulation of the Blood so fully before. And I have so lately mentioned in a general way the use of the parts of the heart considered as a Muscle, that I need only now recapitulate what was then explained for the sake of connection.

You know that our blood is passing continually in a circle, this appears from the structure of the Neck of the Arteries & Veins & from the Valves found within them, which allow it to pass in one direction only. Or you know this from what you have all seen in Living Persons viz^d The effect of a Ligature upon the Veins, causing them to swell beyond it. Or in the Amputation of

545.

of a limb you have observed, That when the first cut is made, the veins bleed from the Extremity towards the Heart; but on cutting deeper & dividing the Arteries, the blood is drawn from the Heart outwards. Or you remember an Experiment done last Friday viz. the Transfusing the blood from one Animal into another. Or viewing it in another way That from a small vessel, whether Vein or Artery, so much blood may be drawn as may kill an Animal. Or a small quantity of Medicine can be diffused thro' the body and be made to pass to every part. And lastly We can show the Circulation of the blood or the passage of it from the Arteries and of Veins.

Similar experiments prove That, blood is passing in that Ducken constantly and with great rapidity - You have all seen

a vast Deal of blood lost in a small space
of time from a vein, and if an Artery is opened
the loss is greater. Or without the appeal to such
examples, the velocity is evidently very great
from what you know of the size & structure
of the parts, as well as from the frequency of
the Pulse, which is generally from 60 to 70
in a Minute, and at each stroke, 4 Ventricles
of the Heart empties itself. Let us then
make a Calculation, and upon the lowest
Data that there are 64 strokes in y^e minute,
and that an Ounce of blood is thrown out
at each stroke, so Four Pounds in a Minute,
And the size of the Ventricles is greater than
Authors imagine, for they are capable of
containing more than one Ounce. I now
suppose that four Pounds pass from them
both in a minute, this is in an hour
will amount to 15 Stone, which is

54⁷ a great deal more than the weight of the
Person on whose You make the calculation,
or the Velocity is evidently considerable.

This also appears when We view the Circulation
thro' a Microscope, after making all proper
Deductions on account of its magnifying power.

Next, You know the cause of the motion &
the manner of it. The Heart we consider as
the Prime Mover, & truly so, for this plain
Reason, That if You fix a pipe into a great
Vein, suppose the Jugular, & then try & exert
upon its accompanying artery, the blood rises
from the tube in the Artery sometimes higher
than in that from the Vein i.e. The Heart
restores to the blood 2/3 of the force with which
it circulates. Next We know more particularly
the Manner of the passage, and Cause, with
the use of each part of the Heart, That y^e blood
flow =

flowing from the Veins into the Aunicle and
 falling it so as to stretch its fibres, partly from
 the irritation, & partly from the use & necessity
 of the Action, the Aunicle contracts, & thereby
 fills the Venicle. The Venicle in like
 manner thrown into action, drives the blood
 with force into the Artery, when the Aunicle is
 again filling; or we know that the Aunicles
 and Ventricles are filled & emptied at the same
 time, but at a diff. time from the filling of
 the Venicles. We observe then that the
 Aunicle serves a double purpose, first it
 stretches the Venicle suddenly to collect it
 to act, so that in consequence of its Muscular
 Structure it is thrown into convulsions wth
 a very sudden Violence. Next we may
 view it as a receptacle for containing the
 Blood, when the Venicle is in action,

where =

549. Whence it prevents the swelling of
particular parts of the Veins - (It may)
be a further circumstance, That the Auricle
is smaller than the Ventricle, and if you
think a little you can account for it, That
in order to prevent accumulation, and the
alternate Distension of the Veins, while the
Auricles are in action the blood passes down
from the veins into the Ventricle, so that
there is a continued stream from the veins.
And this explains another circumstance, the
Want of Valves between the Veins & Auricle
which seem as necessary as between the
Auricle & Ventricle, this however would
have occasioned the accumulation, which
the want of them prevents, and the Auricle
Ventricle is not completely filled by the
Auricle, but the flow from the Veins at
the

the same time contributed to the Distension.
 Next, The Aunicle is much thinner than the
 Ventriculo, so it is foolish to consider the
 Heart as acting like a Spring. From the
 thinness of the Aunicle it is evident that
 the resistance made by the Ventriculo, as
 soon as it is emptied it is relaxed & yields
 to the Distension from the contraction of
 the Aunicle.

Next, You surely conceive that what is
 said of one side of the Heart, applies to both,
 and that both sides are in action at the
 same time. In proof of this we need only
 observe that in living animals we see
 this; and both Aunicles & Ventriculos have
 a common Septum, so that they are so
 intimately connected that we cannot
 suppose the one to be shocked without
 affecting the other.

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affecting the other, nor can the fibres be
 supposed to act in a partial manner, so
 the two Aunules act at the same time, and
 the Ventricles at the same time, but the
 Aunules & Ventricles never act together,
 the Ventricles as being stronger are collected
 to act first, then the Aunules are brought
 into play. Hence the Cavities of the Heart
 are never all filled at the same time, It
 shows & plays freely within the Pericardium.

Now, Next let us attend to the effect of the
 Heart on the Arteries, and let me before
 entering upon this show a very simple expⁿ,
 viz. The Aorta cut out & kept in spirits It
 possesses a great deal of Elasticity, when
 I lengthen it out it extends & recoils to
 near about $\frac{2}{3}$ of its length, or more than $\frac{1}{4}$.
 and when I stretch it sideways it is
 like

Like manner Spins its Diameter Let us
 see then the effect the Heart may be supposed
 to have upon the Arteries, and the effect
 which these again may have on y^e Blood
 they contain. You all know that y^e Arteries
 strike the finger with considerable force—
 Authors generally say that this is because
 they are dilated, or their Diameter increased;
 but of late Years another motion which
 had been overlooked was just clearly
 pointed out to us by Dr. Wobright of St.
Petersburgh viz. its elongation, and Change
 of place, and few^r repeating His experiments
 have persuaded themselves, that the stroke
 is not owing to an increase of the Diameter
 but much to this circumstance; We would
 at first sight rather conceive that an Artery
 by being filled with blood would be shortened
 but

But where can Artery Descend *superintendens*
 These are most objectionable in an injured subject.
 Nay, some have attempted to prove the
 impossibility of a change being made by
 Dilatation, They alledge they did not see it
 looking to an Artery, and they have
 entered into calculations. Thus suppose
 a single ounce of blood comes from the heart
 at each stroke, when that is diffused in
 the Arterious System, the difference in
 Diameter should be inconsiderable among
 perhaps 20 pounds of blood. For Malp has
 shown that if an Animal is bled to
 Death slowly it loses $\frac{1}{20}$ of its weight, and
 yet the blood ascends in a tube from the
 Carotid Artery to the height of Two feet, and
 all the Muscles are of their Natural Color,
 so that in a Dog weighing 200 lb, there
 must

534.

must be 50 lbs of blood in the whole
System, & 20 lbs at least in the Arterial System;
so that such a small quantity among 20 lbs
of blood cannot make any observable difference
in the Diameter of an Artery. But upon the
whole We may with safety conceive, That the
stroke given by the Artery is partly owing to the
Dilatation of the Artery, partly to its lengthening
out, and Change of place; for an artery yields
as readily to the increasing of its Diameter as
to its elongation; it is more especially constructed
for Contraction for the lessening of its Diameter,
from the Disposition of the circular fibres which
are truly Muscular. and add to this a fact
which is denied by Mallet, only because He
has not attended to the experiments, Namely,
That the stroke in our Arteries is not given
at the same time in all, but there is an
evident

555. Evident & perceivable succession from the
Heart outwards. So when I lay one hand on
the Carotid Artery, and another upon the Artery
on the top of the Thorax, the stroke of the one goes
before that of the other, and the succession is
sufficient to prove the Delatation. This however
in experiments on living Animals is not so
easily observed as we would expect from know-
-ing the fact, for the Disperceptions of the Heart
affects us so much, that we conceive the motion
to be greater than it is in reality, That the
Elevation & Change of place likewise contributes
is beyond all doubt, the Artery shifts a little
every time the Venticle is stretched.

But the Division of the Arteries into so many
minute Branches sent off at diff: angles, and
the impulses being communicated to such a
quantity of blood, the stroke comes by degrees
to

to be left off, and the blood flows by an almost equable stream to the beginning of the Veins, and as there is no alternate stop made at the knee, we see the flow almost uniform, except in a small part of the veins next to the Heart which partakes of its structure.

Next, By what powers do the Arteries push forward the blood into the Veins? Are we to suppose that the Elasticity is sufficient, or that the Arteries are merely elastic substances; or are we to add a Muscular power? That the Elasticity has effect is evident, but then it occurs that the Elasticity of the Arteries gives no additional force, for as much Velocity as the blood gains in consequence of this elasticity, so much exactly has it lost whilst the Heart is in action. May the very purpose of making them Elastic is to allow them to elude the force of the Heart, that the blood may not be

53⁷ be driven with the full force of the Heart
into the extremities of the vessels, but that it
may divided, or we consider the Beaction of
the Arteries as the continued impulse of the Heart
or we find this added to the Muscular power—

That they are Muscular we must allow from
a variety of circumstances. Some doubts have
been raised with regard to this by Haller But
they are not sufficient to oblige us to desert the
Common opinion. Haller himself describes
the fibres of the Arteries under the name of
Muscular, but viewing the causes of Spasms
He supposes the larger arteries to have some
small degree of muscular power, but that it
is wanting in the Arterial System in general,
whereas the further we go from the Heart the
more observable it becomes. Let us compare
other appearances. In Dyspnoea there is a
resemblance in structure to the Intestines,
and

and the fibres to the Eye are like to Muscular,
 They have the paled colour, & are joined bodily
 to each other by Cellular membranes. And
 contrary to what Haller alleges the Animals
 receive Strokes, which is proven by the following
 experiment, I cut thro' the Cortax a half
 Prof. where it comes out from the Head, and
 after the Head is cut out, this animal can
 move its body for an hour & upwards. I then
 touch'd the inner side of the Cortax with a
 Solution of Opium in Water, and I only wetted
 it, so that there was no reason to imagine it
 was push'd forwards, yet in a few minutes
 the most distant muscles of the body were thrown
 into convulsions, as when the Animal was
 violently affected with Opium. &c. The Animals
 have it so, which Sympathize out every
 part of the body. Next, When making experim. H
 on Living Animals I think the Muscular
 power

559. Power is abundantly apparent, Not That We
see a contraction equal to what we w^d expect
from touching the pulse, for the vis percussoria
is almost infinite. But upon incising the
Artery of a living animal we observe a degree
of motion particularly where we let out the
blood from the arteries so as to kill the Animal,
They accommodate themselves to the quantity
remaining. At first the stream is larger
perhaps than a fair quill, but some time
after it becomes not larger perhaps than a
piece of sewing thread, and again on keeping
the Animal till the parts are cold, the Artery
appears lesser than in Life. So the change
is not merely owing to the Elasticity, but to
the Muscular Power added, and Verduchin
in a Treatise on this subject has made the
Contraction more certain by a number
of

of Experiments he saw evidently the Muscular
Coat.

Or Latus attend to Phenomena occurring in
Diseases or Accidents. Do we not perceive the
action of the small vessels in fits of Anger,
or in various Diseases, & without insisting on
Proofs, which from not being general are less
convincing as the Difference of frequency in
the Pulse in certain complaints, as when one
arm is affected with Palsy, when the stroke
of the Pulse in that arm does not correspond
with those of the Neck. Latus attend to the
alteration in the glandular organs by irritation
where not only the quantity is increased but
the liquor changed. Or Latus attend to
the effect of Topical Stimuli in producing
Inflammation which has been insisted on
by Dr Whyte, as when Powder is laid into
one

56. One Eye, That is inflamed & not the other, wh
is not in consequence of the Heat being raised
into action; otherwise both eyes would suffer;
But the vessels of the part themselves are brought
into a more violent degree of action. Now is Dr
Galle's objection sufficient to make us Relin-
-quish this notion, That in one place Dr
Whyte speaks of the action of the vessels as
serving to promote the Circulation, and in
another place he makes the same action to
Cause Affections as in Inflammation.
Dr Whyte himself did not live to explain
the Objection, but I apprehend he may do
that readily. If we suppose the action
of the vessels begins from the Heat & proceeds
towards the extremities, the gentle action then
pushes the blood onward, but if some strong
irritation is applied at a distance from
the

The extremity of the Vessel, and the action
 begins in the place irritated an Inflammation
 may be produced. Just as in the Alimentary
 Canal, where there is no Vis a tergo, but the
 aliment is pushed on by the Muscular Coat,
 if any part is irritated it contracts violently so
 as to prevent the descent of the food. I suppose
 there was Lacteal Branches here, the Contents
 would be drove with violence into them, &
 if these were so small as ^{not} to admit of any
 part readily, an Affection must take place.
 So in the Vascular System of the blood is forced
 into such vessels as admit the Serous and
 Lymphatic fluids but not the red globules
 We conceive Affections to take place.
 Now to conclude the Proof I thought of trying
 by Expt. By exciting inflammation in the
 transparent part of an Animal, and I remarked
 that if a part be irritated with any acid ^{which}

563.

which gives pain, as when we touch the very
transparent Membrane of a Trof with weak
M.C. in a few seconds there is an increase
of redness, and an enlargement of the vessels,
and at length a stoppage of the blood in many,
and in the Intestines of the vessels a red color
produced, but without a globular appearance,
and which is owing to the Red part of the
blood having coagulated with the watery part.
I then destroyed the part with a red hot iron
& allowing the Eschar to cast off, I again
had recourse to the Microscope, & I perceived
the Red Matter in the Intestines of the vessels.
I again touched the parts with the M.C. &
immediately I could plainly see an in-
-creased redness round the edges, and in
a few minutes the blood was Motion in
a stream from a number of Moulds. It
might be supposed that this depended on
the

The pain given to the animal, but the renewed motion was owing to the vessels themselves, because on incising a distant part no such effect followed, and after the large nerves were cut thro' all the same appearances were produced. Upon the whole therefore we are led to suppose a Nudly Muscular & living power in the Arteries, and that the smaller arteries receive that in a greater degree than the larger —

Lect. 46th

At our meeting yesterday, after recapitulating the general proof of circulation, and of the use of the sev^l parts of the Heart in promoting it, We consid^d the course of the Pulse in the Arteries, & found that it depended upon partly their dilatation, & partly on their elongation and Change of place, both produced by the force of the heart. Next I proved that y^e arteries
re=

565.

React not merely by their elasticity, but that there is superadded a Muscular power of the Arteries, as appeared from a number of experiments which I then enumerated. —

Perhaps we may add that in Old Persons where there is a considerable degree of Weakness the Operation of Arteries has been sometimes a Cause of modification, the Heart alone being insufficient to push the blood thro' them without this power. —

Next, pursuing the Subject, We conceive from the Quantity of blood contained in our body, from the vast number of Branches the vessels make, from the great size of the Branches when compared with the Trunk, and from the extreme smallness where they join the Veins, that yet impulse must be in a great measure lost, and the flow of the blood become more equal, tho' the elasticity & Muscular power continue the

The impulse after the Heart ceases from acting.
 To viewing the Circulation in the extremities of
 the vessels with the Microscope, we see, a stream
 almost uniform. When we compare powers
 of the Heart & Arteries in the larger branches,
 the force given to the blood by the Heart is much
 greater than that communicated by the Arteries.
 In some operations where the Arteries are cut, the
 blood is thrown at a distance, but the force
 is much greater when the Heart is in action
 than when the Arteries react. Next the
 Impulse of the Heart carries the blood with
 greater force, & further than is generally supposed.
 For in some experiments I have observed the
 effect of the Heart in the beginning of the Veins.
 Some a Prof. while it is in vigour the flow
 seems rapid & uniform, but when the Animal
 is much weakened, you can observe the
 stream becomes slower, and you can count
 the

56^y. The strokes of the Heart by looking at the Veins;
So that the heart pushes the blood on into y^e veins
or there is a vis a tergo independent on the power
from their own structure.

For the Veins possess a Muscular power likewise,
Having red flesh Coloured fibres running much in
the same manner as those we saw in y^e Arteries.
And this also appears from what happens in
the Cancers on the Lymphatic system, which
forwards its contents into the Heart after Death.
So we must suppose the same thing in the Ed
Veins; Nor is it any argument against this
That we find blood contained in them, as there
is no replace sufficient for it; but if there
had, as in the Heart itself I suppose, I have no
doubt but that we would have found
the Veins emptied nearly as accurately as
the Arteries. And I shall show you proofs
hereafter That our Veins can be inflamed
and

and Muddy thickened. I have perceived 568.
Myself a degree of pain in opening a vein, but
the skin first, and on cutting the vein slowly
with a lancet, I was sensible of a degree of pain, tho
not near so great as on cutting the skin.

To the Muscular power of the Veins, and the force
communicated to the blood, we must add the
effect of our Muscles, when we act with them
in Walking, Running &c. So in letting blood
You know we get more by acting with the
Muscles, the push being continued forwards
to the Ventricle by means of the Valves, and their
only use is to determine the blood in this
course, For they do not diminish or increase
made on the sides of the Vein by dividing the
columns into parts, for when the blood is in
motion all the Valves are opened, & finally
the Weight whether in motion or at rest is
nearly the same —

After knowing the Circulation, before we

509. We quit the subject, We would wish to understand
the principle upon which it serves.

First, You have seen that the duct through
which our Nourishment is conveyed termin-
ates in the Red Veins, or the Chyle is mixed
with the blood by circulation. The Chyle
somewhat changed is conveyed round in
Arteries to the Mammary, and by the repeated
Application a sufficient quantity is collected
for the Nourishment of the Child.

Next, the remaining Chyle by repeated currents
We must suppose converted into blood itself;
for an Animal grows from a small beginning
by the Chyle entering the System, and
undergoing an after change. And when we
compare the different organs of the body
with each other, we would conclude that the
Red part of the general mass is formed from
the Chyle chiefly in the Lungs, as when
We

We compare Breathing Animals, with those
 which do not, and from observing the effects
 the air has upon the Mass. Next, after the
 Mass is completely formed, it is very much
 disposed to Coagulate, and that without the
 access of the air assists the Coagulation, but it
 can take place independent of the access of
 the air, and the Circulating motion prevents
 this change from taking place. Next, every
 part is better nourished by repeated Applications
 of the Nourishment to it, than by a single
 one, and I shall give You a Demonstration
 that the Liquor directly applies Nourishment.
 Next, We find that in many parts of y^e body
 Secretions of Masses of Liquors are made, as from
 Glands, which do not discharge their Liquors
 from the body, but they are taken back
 again, so these Liquors are collected, and
 the

671. The proper changes made by the Circulation.
Next, by the effect of the Circulation many
parts which are useless and even hurtful
are thrown off, as by the Kidneys &c.
Next, It keeps up the sev^l vessels & promotes
their growth, It stretches the parts of a young
animal, and gives room to fresh particles
to enter, so that the growth of the body is
maintain'd. Next, supposing the Growth
completed, but that by any accident there
is a loss of substance, it is supplied by the
Elongation of the vessels, and I have shown
that the manner of the Supply is very curious.
Not only do the elongated Arteries find their
Veins, but from opposite sides of the Wound
They are reunited.

Besides these obvious purposes, there are perhaps
many others that are connected wth Circulation,
Let

372.

Let us turn our attention a little to the
Diseased parts which I have shewn, and on
which I shall make a few cursory remarks,
where the causes of symptoms occurring in
practice do not seem sufficiently pointed out by
Authors, or the manners of distinguishing one
Complaint from another.

From the Structure of the Vessels it is evident
That our Vascular system, as well as the Meat
itself, may be subject to Inflammation and all
its Consequences. That is, If the Inflammation
Does not disperse, we can conceive a Suppuration
to happen, so far as this takes place in
Membranous parts, where Suppuration is
more difficult, and where it occurs on the
inner side of the Vessels, we are less able to
prevent it by Dissection, because the part
is washed by the current of the blood. We
would suppose that a Schiurus may take
place

573. place in the coats of our Vessels, or that Gangrene
may be formed; and I think we have instances
of both these before us. In some of the specimens we
find the surface of the Arteries unequal, in others
the inner coat is eroded & the outer so weak
that a slight effort makes them give way, or
we see a degree of erosion, a suppuration & this
ending perhaps in Gangrene; & we observe
specifications within the Muscular Coat, which
may be compared to Abscesses in the Glands &
organs, as of the Breast, only the matter spread
into the Intestines of the Vessels is different.

There is still another kind of Inflammation
which has not been sufficiently attended to;
Tho' a person escapes Suppuration, Abscess &
Gangrene, yet he may be cut off by Death
from the Inflamed organ affecting the A.S.
If the beginning of our Aorta touch'd wth Ulcerum
can disorder the whole A.S. so as to render the

The muscles unable to perform their usual operations, the beginning of it being inflamed may kill a person, without any Mechanical Stoppage, but a Delation at this part of the Aorta. And in many cases where a Person Died suddenly, & there was no Mechanical Stoppage, but a Delation at this part of the Aorta, I apprehend that the Heart & Arteries affected, disordered the whole System & hurried thro' the Staves, & that in this way Death was brought on.

Next, We have seen a Connection of the Pericardium to the Heart, and where We find descriptions of the Want of a Pericardium, this has probably occasioned the mistake. In other cases We find the Pericardium greatly stretched out & filled with Water, and this evidently must have great effect on the Heart itself on account of its pressure. Next on cutting the

575. The Heart we find That the blood sometimes
Coagulates within it, That Polyppi are formed
Not that this is so frequent as former Anatomists
imagined, who finding Concretions not of a red
Colour, Hencevery Mistaken as the Coagulating
part, They considered That change as an effect
of Disease. At the same time we must allow
That there is such a Disease as real Polyppi
existing in the Heart. Thus I show you
one in the Left Ventricle, and the flesh
of the Heart affected by it. The Patient had
perhaps fainted, & in time of it a Concretion
of the blood in a certain degree had taken place,
wherein the after action of the Heart was not
able to resolve, & the Concretion remained in
the part of the Ventricle the most out of the
Course of the blood, so that by Degrees this
Concretion became firmer & firmer & formed
the Disease you see. And from this very
Case

Case I can have no doubt that Polypus ^{376.}
exists before Death.

Now, We pursue Affections taking place
frequently at the mouth of the Aorta, & extending
thru' almost all the Arterial System; only here
the whole force of the Heart is as it were collected
especially on the Left side, so Affections must
happen here more frequently than elsewhere.

Now, Let us see how a person may distinguish
these several Affections; For tho' perhaps we
cannot cure the Patient, we may help to
prolong his life; By forming a just prognosis
We are enabled to distinguish the Incurable
affections, from others which may admit of
Cure, so it is of consequence to attend to the
Symptoms which they produce.

Now, with regard to the Connection of the
Pericardium with the Heart, I have had no
opportunity of examining any Person labouring
under

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under that Disorder, and The Gentleman who
gave me this paper told me That the Patient
only complained of a smarting about his breast.
But this must be the consequence of a very
considerable degree of Inflammⁿ about the heart.
So that we are led to discover the Disease
by the previous Circumstances, as by the pain
in the side, the Anxiety, & the quickness of the
Irregularity of the Pulse, which is much
greater here than in other Cases of Inflammation,
tho in all the other Diseases of the Heart, the
Pulse is generally irregular; for there is a
strong Sympathy between the rest of the body
and the Heart, and the feeling of the Heart
itself is particularly delicate. I think we
should add That the degree of Inflammation
which has previously taken place will
connect the Pericardium likewise to the
Ch

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External parts so as to tie down the Heart
in its place, & that the Stroke therefore will
be felt nearly in the same manner in all
postures of the body.

Again, if a Person labours under Water in
the Pericardium, I apprehend We will Judge
of this from the general Symptoms of Dropsy
in the Thorax, as a Dropsical habit, a
Pain of Urine, a Palenest, The Patient is
more oppressed, more than when Water
is contained within the Thorax, & especially
when He lies on his back, when the Water
comes to gravitate upon the Veins & Arteries
entering the Heart; and further I am fully
certain that in no posture of the body can
we discover the Stroke of the Heart, for it is
tyed down by its vessels & buried under
Water.

Next, with regard to Polypiformity within
the Heart, We may Judge from the Patients
have =

579. Having fainting, or even this having laboured
under some highly Inflaming Disease, which
disposes to that coagulation, from a great
Degree of faintishness being produced in
certain Postures, while other nervous Symptoms
are wanting.

With regard to the Gasp taken at 4th months
of the Quinries, I apprehend that we are
able to form a probable conjecture of its
nature. I have seen it in 8 or 9 different
Persons, & I have disputed that the Number
and the rest died suddenly. Now 4th marks
are these. The disease comes on slowly, the
Patient feels an oppression about the breast
which he cannot account for, a kind of tight-
ness, the blood stops in the lungs. He is
often breathless when he walks quick, when
he walks up Hill, or climbs a stair, he
must stop to make a full Inspiration, he

The complaint of a pain & burning heat
in the very region of the Heart, and He is
fond of having the Windows thrown open,
and yet when You examine His hands and
Feet, there is a sensible degree of coldness,

The Pulse is very unequal and irregular
and that in every situation of the body, and
It is always more frequent than in Health.

His strokes are very unequal in their strength
one stroke being much fuller than another,
and if the Disease has made considerable progress
We are able to reckon many more strokes
of the Heart than We can of the Arteries —

So in one case I remarked that when y^e Patient
was laid on the Left side, the Strokes of the
Heart were 120 against the side in a minute,
and yet in the Arm I could not reckon above 80.
Nor from the smallness of the Passage the
Stroke is not continued so as to become dis-
= long =

=irrepressible till the Heart is overladen
 with blood & makes a greater effort. But the
 principle symptom is that it brings on a
 Dilatation of the Heart, so that the point strikes
 the ribs lower than the usual place, that is,
 generally between the 5th & 6th ribs. Now if a
 Person leaning over receives the stroke about
 the 7th 8th or 9th rib, You may pronounce
 certainly that the Heart is dilated, and
 there is no cause of this so frequent as the
 Operation at the mouth of the Venicula.
 This Dilatation of the Heart may appear some-
 =what puzzling; You readily conceive
 Now the arch of the Aorta may be dilated,
 because there is a stronger power, in Venicula
 acting against it, but the Heart is not dilated
 by the flow of the blood into it, for the blood
 from the Veins has but 1/10 of the momentum
 which it has in the Arteries. But the
 end=

endeavours of the Head to contract are the
causes of the Dilatation, by endeavouring to
overcome the resistance its fibres are strained
gradually lengthened out. This may
appear somewhat Paradoxical, and yet I
imagine We may explain it by an example,
Suppose a twisted rope to be tied round this
table, which will not yield, and afterwards
if I pour Water upon it, it endeavours
to stretch itself; and if I allow it to remain
till it turns dry, I find it loose about the
Table; as the parts that have been strained
do not recover their tone, and in this way
We may stretch it very considerable. So
every effort the Head makes to contract in
order to overcome the resistance, tends to
bring on the ~~resistance~~ Dilatation. There
is another appearance which I find
more difficult to explain. This may

583. I show you weighed upon trial, about
Double the Weight of the Heart of a Person of
the same size, and yet on cutting I did not
find a quantity of the Sebaceous or oily
matter in the interstices of its muscular fibres, but
the Flesh was nearly of the common appearance
there was a real addition made of the
Muscular matter. I cannot tell in what cases,
but the same takes place in Dilatations of
the Arteries; Where these are Dilated you
can demonstrate the Muscular fibres in it
more distinctly than in a sound Person.
It still remains that we should attend to
the Dilatation of the Heart a little further, &
likewise of the Arteries, and to the rupture
of both, or to their aneurismal state. I
have explained how the Heart may be dilated
the Dilatation of the Arteries is more simple.
Sometimes all the Arterial System, and in
many

many of the Special Dilatations a disease
 may have been produced, the Artery weak-
 = end there, in consequence of which y^e Part
 gradually dilated the part. But there is no
 Reason to be discovered for some of these
 Dilatations, as that of the General Artery
 in different places of it, We may offer a
 Conjecture about it; perhaps a pressure might
 be made there, and the Artery forced to
 overcome the Resistance, so that it comes
 to be dilated by endeavouring to contract,
 or there might have been a Palysis of
 that part. Now, the Arteries can be dil-
 = ated in particular parts of their Course
 so that Pouches or bags are made sideways
 and joined to the Arterial System. We find
 these produced in a manner which We
 can still better understand, that there
 is

is a general Delatation till it meets with a
 resisting substance, when its coats come to
 be diseased, after that they yield most
 where they appear to have yielded least,
 from the change the pressure produces in
 their texture. Besides these changes
 You can understand the appearances which
 Wounds may make by dividing some of
 the coats, while the remaining coats are
 still sufficient to contain blood. And you
 still more readily understand the appearance
 of blood let out by puncturing all the coats
 which may be confined by membranes
 passing over the artery. We see likewise
 that there may be marks by which such
 swellings can be discovered with some
 degree of probability, but there can be no
 certain mark but the feeling of motion
 with the hand; for other diseases produce
 the

the same feelings as the swelling of the
 artery, and after we are able to distinguish
 the motion, still there is room for deception,
 unless we attend to the progress of disease,
 or unless we are able to alter the shape
 by pressure, for neighbouring arteries convey
 their stroke to bags which give a feel like
 aneurism. In order to put you on your
 guard in such cases, I used to mention a
 case of this kind from England, w^{ch} regard
 to which sev^l of the Physicians of this
 place were consulted. A Gentleman
 was supposed to have an aneurism between
 the a^o & 60 Arteries, & from the uncommon
 situation we wish^d to be inform^d of y^e
 previous history, but we got a very laconic
 answer, That some Gentlemen of the first
 Rank in London were unanimously
 of opinion that the disease was aneurismal.

587. I have learn'd however since, That the
Disease has proved very Difficult, So it is
necessary to trace every Circumstance from
the first formation of the Disorder. —
with regard to the rupture of the Heart and
Auricles, That of the last is not difficult, But
How are we to account for the Rupture of
the Heart? The Auricle is a weak part
and we may suppose the blood forced
into it, and That a Person makes a violent
Effort of Expiration, by which He hinders
the blood from going thro' the lungs, in
consequence of which it is burst, & This is
one reason Why Valves are wanting
between the Auricles & Ventr. But How
are We to explain the bursting of the
Ventricle itself, as in the Case of the
Late King, who Dyed of a rupture of the
right Ventricle; & I shoud' you a case of
the

The bursting of the Spleen betwixt the
Nerveless. Now if we keep only to the
common Idea of the force of another organ
relating them, we find no explanation of
the Phenomenon, But if you recollect what
I had occasion to show you, That the bellies
of Muscles are tore by their effort, you can
explain why the strongest had such way,
or How the Heart may tear itself from a
sudden spasm, by the violence with which
it endeavours to act the fibres are here asunder,
while in other Cases they are only gradually
dilated.

Sect. 15th

We have hitherto considered the Heart with
the Arteries & Veins as much serving the great
purpose of Circulation. We are now to
attend more particularly to the Mechanisms
of the Arteries & the opening of the Veins.
But

589. But in order to form a proper Judgement
concerning these, it is necessary that I begin
with demonstrating to you the Structure
& the Course of the Valvular Lymphatic Veins.

When We examine these Veins in a
Living Animal, they generally appear both in
their coats & in their contents perfectly
pellucid, Hence the name of Lymphatic;
and examining their Structure We find
that they are every where crowded with
Valves in a much greater Degree than of
Red Veins: in some places we can reckon
8 or 10 pairs in the Length of a single inch,
and there are few places where we do not
find one, two or more pairs in the same
space. The coats of these vessels though
perfectly transparent, & very thin, have
a remarkable Degree of toughness, They
sustain a much greater Column of Mercury
than

than the red veins can be made to do. 590.
and we have strong reason to believe
that they possess a muscular power. For I have
repeatedly observed that about the death of an
animal, especially if a wound is made in
the thoracic duct, they shrink very greatly
in their size, and they appear smaller at the
very time of death than they do afterwards,
just as I observed with regard to the arteries.

And this power of the Lymphatic system is
in general such that by giving an animal
coloured food, we fill the system called lacteal
on the coats of the intestines, & it after death
the white colour disappears, the vessels empty
themselves of their contents in the most
accurate manner. The valves are exactly
of the same structure as in the veins &c
we find two valves which completely stop
the vein, & between each of which the space
is dilated. Some have delineated them
as

591. as cylindrical, but they swell out where
red veins where the valves are placed, that
the Lymph may get behind the valve so
that it ~~may~~

Next, pursuing these vessels towards y^e Heart
We find that they enter the gland called lymphatic,
and the manner is this, When they come near
to the gland they divide into a number of
Branches, some of these pass over the gland
adhering to it slightly, but others divide into
a great number of parts, & touch deep into
it, they cover their surface by their number
forming a plexus upon it, so that when a
very accurate injection has been made, the
gland seems to be converted into vessels, or
to consist entirely of the Branches of the
lymphatics. Now I know certainly that
in every gland the branches in y^e middle
of it open into cells, that the liquor is exp^d
it

592.

it were extravasated, gets out of its cylinder
refills into the cells, & is taken in again by
Lymphatics with open mouths upon the
opposite side, just as you have seen in the
Penis a cellular part filled with blood. I do
not mean to say that the liquor is sucked in
from these cells, it is drawn in, because I can
imitate the process by injections. I can make
the liquor pass from the one side to the other
just as in the Penis. The Lymphatics going
still further do not immediately reach the
Heart, but pass over or thro' a succession of
glands, so Authors, as Winslow, speak of
Lymphatics of the 1st & 2^d order, i.e. a Lymphatic
enters one gland, leaves it, enters a 2^d &c
But the same thing is true of the whole
Lymphatic system. The Lymph is shunted
thro' a number of glands as it proceeds upward
to the Heart, and every where in the course
of

of Lymphatics, like the Red veins, have numerous Anastomoses, these are few most remarkable near the Spleen & glands but they are to be found every where.

Now so far we may remark of structure of the Lymphatics, next let us endeavour to trace their Course & termination, which is of consequence to be understood.

We begin with the most distant parts of the body, following the course of the liquor within them, You will recollect what I mentioned of the Red veins, because it applies here, that in the deep organs where the pressure is nearly equal, we find but one set of veins corresponding with the Arteries, but in the Muscular organs where the pressure is unequal, we constantly find two sets, one accompanying the Arteries, and the other as much superior the compression of the Muscles

394.

muscles as possible; so here we find the same thing in the Muscular parts and in the extremities of our bodies, as well accompanying the Arteries & another Substances; and the last in fact follows the Corresponding Veins, take support & assistance from them, so that if we understand the course of the red Veins we in a great measure know that of the Lymphatic System.

From the lower extremities the Lymphatic Veins go to the Upper & Inner part of the Thigh, where we find the number of Branches increase, & networks form'd by them, a great number of them going into Clusters of Inguinal glands, and from these running into the body behind the bend of the External Oblique, where they join with the Lymphatics from the Pelvic Abdomen, & with the Vascals from the Chyliferous

Ves-

595. Viscera, and all these unite to form the
Thoracic Duct, which in its passage upwards
receives the Lymph from the Head & Neck,
The Left arm & Left side of the head & Neck;
while on the right side the Lymphatics of
the Head & Neck go into the veins of the right
side; tho' in some few cases, after the Thoracic
Duct gets above the arch of the Aorta it turns
towards the left side, then makes a turn
over to the right, & terminates at a junction
of the Superior & Subclavian veins, receiving
therefore the Lymph of the whole body —

I next shew You some swellings of these
Vessels in Diseases, which happens more
readily in the Mesenteric, and We often
find an ulcerous appearance of the
Intestine which was the occasion. There
is often too a Cancerous matter found
within the Cells of the Glands — I shew
You

546.

You another proofⁿ where the Thoracic Duct
of Two Cops are pursued, that I found filled
with blood after making incisions into the
abdomens of these animals —

Lect. 43th

Now that we are fully acquainted with
the structure & course not only of the Arteries
but of the two very different kinds of Veins
found in our body. I shall attempt to determine
the way in which our Arteries end, and the
different kinds of Veins begin; or in the
latter enquiry I shall separate ² Circulaff
Veins from the Absorbent, and I would
alledge that in practice the knowledge of
the latter is of equal importance wth that
of the Circulating itself.

You know that from the Artery liquors
are separated, in some places of the Body
the Apparatus for this separation seems very
simple

simple, while in others it is much more complex, as in one place a liquor is poured out without seeing the organ from which it comes, in another we see a large mass to which we apply the name of Gland.

Where no organ is seen by which a separation is performed, some have conceived that there are inorganic pores by which the liquor exudes, which old opinion has been lately revived, thus imagined there is a vessel very curiously organized, possessing the muscular & nervous energy, & they call it an Exhalant Vessel.

Now of these two notions, I am persuaded that the most common is the best, that there are in reality organized Regularly disposed Exhalant Vessels, for every circumstance contradicts the other supposition. For as the Liquors in the Peritoneum, Cavities of the Abdomen, Pleura &c. do not merely pass

pass from Arteries, but are intended for 598.
Lubricating the inner sides of Membranes, so
We must suppose pores regularly disposed
in their Membranes. Besides We find that
these liquors differ remarkably in their properties,
may the variety is nearly as great as where
there is the more complex structure of a gland.
Thus I am receiving out a somewhat thick fluid
to life from the Lungs, yet it is separated
without the intervention of glands; Again,
besides the Mucous poured into the stomach
I am separating juices there, which act as
a Menstruum upon the food; Again, from
the Skin there is a something very different
separated, and there is a variety in the liquors
separated in the Joints, where there is no doubt
that the small vessels concur in producing
a liquor with the larger glands that We
can demonstrate. Now, When We make
an

an injection in a living Animal, the injected
 liquor passes more readily into certain cavities
 than others; and in some cases as in the
 Villous Coat of the Intestines, the real humen^{ed}
 of these exhalant vessels has been made visible
 to the Microscope, We can make a coloured
 matter pass from the extremities of exhalants
 into the cavity of the Intestines. Further, in
 proof that the functions are regulated by
 a Muscular power, these said to be proof
 by Exhalant Vessels are affected by spasms,
 Thus, if a Person catches cold, there is a
 stoppage of vessels pouring out matter
 on the skin, & a greater determination to
 the cavity of the nose perhaps, or in any
 instance to the Intestines producing a
Diarrhoea. So every circumstance concurs
 to prove that there are regular organized
 Exhalant Vessels, which we cannot expect
 to

to trace with the Eye, when they exclude
the Red Globules which we see wth Difficulty
with good Microscopes. Next, We find that
a number of Vessels run into the Glandular
Organs, and after running a certain way We
find them so complicated that We follow
them with Difficulty, and from y^e opposite
side of the gland We see coming out our
Arteries, &c.

Next, Tracing our Arteries wth the Microscope
to their extremities, We see them divide into
very small branches which Circulate the
Red Globules, and where the Red Globules
pass thro' with Difficulty. But in many
places of our body the Red Globules are much
excluded, as in the Cartilages, Tendons &c or
in the clear part of our Eyes, where not only
vessels conveying Red Blood are wanting in
Number, but we cannot force a Coloured Powder
into

into them by the utmost force of Injection.
 So we are under the necessity of supposing
 that there are Arteries of descending series, which
 exclude the large & visible red Globules, & admit
 only the Lymph, the Serum, & the Water of the
 blood, and I am at a loss to say whether
 there are as many orders as I have mentioned
 of Liquors, or one Globule's small artery
 receives all these. I am disposed to believe
 that there are descending series, that some
 exclude the Lymph, & even the Serum, and
 allow only the pure Water to pass through
 them, but without entering deeply into
 this question we shall call these Globule's
 Vessels, Lymphatic, Serous, or Aqueous,
 tho' perhaps the best name for them is
Lymphatic, as that is the Liquor which
 is most first circulated. Now so far
 the Description agrees wth the Systematic
 Writers

Maters, except that I have excluded the
Inorganic pores. To deny a porous oxidation
altogether would be carrying the matter too
far, some thin Volatile parts may pass
thro' the coats of our Vessels, but we are not
to conceive that the secreted humors in food
are separated in this way —

A greater Difficulty remains, To trace the
parts of the blood conveyed by these several
tubes back to the Heart. We can describe
the termination of the Arteries, but there is
great Difficulty in determining where the
Veins begin, from their being two sorts of
them — We perceive in general that there
must be circulating Veins corresponding
with the circulating extreme branches of
the Arteries, and in many parts of the body
where there are secret sacs, there must be
imbaling or absorbing Veins to correspond
with

603. with the Exhaling Arteries - Now from there
being two sorts of Veins, We shall find a
possibility of forming variety of Suppositions.

I shall begin with the opinion of the Sys-
tematic Writers - They suppose the Circulating
Red Artery to terminate in a Red Vein, the
Circulating Sympathetic to terminate in a
Sympathetic Vein, passing thro' or over the
Conspicuous Gland, and the Exhaling or
Inhaling branches which open into the
Dorsal sacs, They conceive to end in the
Red Veins. Now cannot we form Suppositions
that will be equally, or still more probable
than these? May Nature's systematic Writers
supposed that all the Colour'd Fluid
passing out into Cavities reach the Heart
by passing immediately into Red Veins?
May have they not rather imagined that
the whole of it goes into the Colour'd Sympathetic

= other veins? Is not this system more probable than the other? Or at least if some humors in the red, we may suppose others to humors in the Lymphatic veins.

Or May we not form a system more simple than any of these 1st. That as an artery at its extremity is divided into red & colourless branches, May we not suppose the red veins to begin in the same way by red & colourless branches, so bring the liquor of the Lymphatic veins into them, and may we not dispose of the Lymphatic system by supposing it to correspond with the Exhaling branches of the Arteries, beginning by open mouths - Or that one kind is employed in circulation & another in Absorption. Does not that appear more simple, & more consistent wth the operations of Nature? Does it not do so more especially if you reflect on the structure of our Urinary Canal

Canal where we see the very same thing
take place? There are very few authors
who have conceived the idea, that the
Lateral vessels ~~put in~~ ^{enter} their contents by
having branches from the Arteries joined to
them. They suppose that all the blood in
the Muscular artery returns by a Muscular
Vein, and look upon the Arteries as quite
distinct, or they conceive this very system
to take place in the Intestines, and why not
then may we do so universally. But let
us see if experiments condemn this
supposition, or let us attend to the several
arguments from the experiments of others.

And first, before we proceed to establish
a new opinion, it is generally a good rule
that the old one be examined, as we are
apt to be prejudiced by it. So let us see
what has led authors into the idea that
the

The red Veins Circulated the red parts, The
 Lymphatic veins the Lymphatic, and that
 all the dissolved liquor went into the red
 Veins. The History of Anatomy seems to
 explain this. The Lymphatic system was
 only generally known in the middle of
 last Century, before that time we have a
 few dark hints about it, which were long
 overlooked or misunderstood. Authors therefore
 had for a long time conceived the red, to be
 the only Veins in the body, therefore allotted
 to them every purpose where the Veins
 can be supposed to serve. And as Doct^r Harvey
about 20 years before, the Lymphatic
 System was known, had proved that the
 red Veins were the continuations of the
 Arteries. When the Lymph System was
 discovered the same supposition was
 applied to it; They were found to be
 Veins

607. Being, that the blood moved in them toward
the Heart, so the same idea was taken for
granted; and as some parts of our body are
coloured & others colourless, They imagined they
saw the veins by which these two parts
were circulated. Some years after this notion
which was merely a supposition gained
credit from experiments, which seem'd to
settle it on the least point of view - For on
repeatedly opening living animals, Anatomists
had occasion to observe that some part of
thick'd blood was contained in the larger
branches of the Lymphatics, or in the Thoracic
Duct, which they thought prov'd their origin
from the Lungs, supposing that by a
struggle of the Venim all these vessels had
been dilated and the blood must in.
And after Ruych had made his experiments
they found that if a colour'd matter
was

was injected with force into the Arteries, it frequently filled the Lymphatics; and this to Cropper was so much a proof, that We tells us that no man in his senses would pretend to doubt of the Fact. And unless Cropper himself had shown a mystery in his experiment, or other Persons had attended to them more particularly the argument seems very conclusive; but We can give a very different explanation of these appearances.

And first How do we find red Globules in the Thoracic Duct? To explain this We must either suppose that the extreme branches of the circulating system are enormously dilated to take them in, that there is an Error Voci, that the red globules pass into the colourless vessels thro' their whole course;

or

or We must suppose That the blood is effused
 and that by the violence done, Veins are
 tore, & the Globules enter by the Lacerated
 parts. Or Thirdly. That the red parts are
 effused from the Arteries, & again suck'd in
 by the Absorbent Veins. Now if we admit
 this last supposition, We give up the
 argument, as We conceive That the Lymph-
 -atics are Absorbents, and yet the redness is
 generally communicated that way. So
 when speaking of the Nature of the blood
 I supposed that the Colour and shape of
 Globules have no manner of Connection,
 That the Colour remains tho' the Globules
 are broke down, and therefore We may
 suppose an Absorption of red parts. So
 if red blood gets out beneath my Skin
 the Colour gradually changes, and the
 yellow

yellow colour of the Serum remains after
 the red is gone, the red part being more
 readily taken in. We know what happens
 in slight inflammations, as in the Eye
 you seldom see the clear vessels of the Cornea
 dilated so as to let in red blood, for where
 red vessels are seen in the Cornea, there is
 a new growth from the white part of the
 Eye gradually extending over the Cornea,
 but the original vessels do not admit of
 red blood, so the extremities of our vessels
 are by no means so easily dilated as
 Authors conceive, but we see either the
 red parts absorbed, or there is a saceration
 of vessels. So perhaps there is a real
 effusion of red blood in the clear part
 of the Eye, as when an accident happens
 to it without pain, and even where
 there

611. There is an Inflamⁿ of the Brain, We have
strong marks of Effusion. So where I have
saw Inflamⁿ on purpose in the brainst
parts of Troops, I could observe with the
Microscope an effusion of red parts —

To strengthen this observation, Let us attend
to the instances of blood in the Thoracic Duct,
Whipple is chiefly quoted for this fact, and he
by giving corrosive sublimate to animals
in large quantities produced the most dread-
ful symptoms, and following the descriptions
of the dissections he made, We find there was
a vast quantity of clotted blood at the root
of the Mesentery, so there was such a
sacration of many parts that y^e blood
might easily enter. But I have now
made many more experiments than you
will find in many authors. And I have
opened this redness in the Thoracic Duct
in

in inefficient Animals, and I find that it
 can be produced by making a large Wound
 suppose into the Abdomen, or by producing in
 any shape a great irritation of a sensible
 organ, it is not confined to any organ, but whether
 You inflame the Spleen, The Liver, The
 Stomach, The Guts, or any muscle, there is
 a swelling, an effusion of blood, and a red
 colour of the Lymphatics proceeding from
 the part. Now let us endeavour to
 explain what happens in Injections, as
 When Mercury passes into a Valvular Lymph-
 -atic. Consult Cropper & Kuch who have
 been chiefly quoted. Cropper tells us that
 He has often injected Mercury into the
Pneumatic artery, and filled up corresponding
 Lymphatics, but could not get it into the
Pneumatic red Veins. Now what explanation
 can be given of that? If You conceive
 a

a continuation of Vessels, Why does the Red
 Blood pass into the Red Veins in Life? Or
 Why does not the Mucus pass into the
 Red Veins? Smith again mentions other
 Circumstances. He injects the Splenic arteries
 finds the Lymphatics filled, but observed
 first that there were vascular quoadam
 filled fish. The injection had burst into the
 cellular substance, & the fact I know from a
 hundred experiments to be this, That if
 You inject an Artery with a very
 penetrating liquor, and with great attention
 so as to fill the corresponding Veins, We
 may give the full colour to the part, without
 filling any Lymphatic; but if You
 take a subject beginning to Putrefy, and ye
 push under, and push the injection wth
 a sudden Violence so as to burst the
 Branches of the Artery, and the Liquors
 penetr₂

punctate into the cellular substance are
 effused every where; You succeed in filling
 many lymphatics without a single drop of
 the Injection passing into y^e corresponding
 Veins; and on cutting open the lower Vein
 sometimes see the place at which y^e Injection
 had got into the Lymphatic, but for the most
 part it is impossible to demonstrate this.

And therefore when we produce this Red-
 ness of the Lymphatic, either the matter effused
 into the cellular substance enters by the
 lacinated branches of the Lymphatics, or if the
 blood has stagnated for a length of time, &
 thick parts are melted down, and may
 be taken in by the very mouths of the
 Lymphatic vessels — It is evident therefore
 That Authors have drawn a wrong conclusion
 from That observation & Experiment, but I
 do not mention this as any proof that the

615.

The Lymphatics are Absorbent Vessels, for
 their branches are generally lacinated, and the
 Injection enters in this way —

Let us mind them well if there are any arguments
 to dispose us to believe That the Lymphatic
 arteries terminate in the Lymphatic Veins. This
 appears very plausible at first sight, but
 what purpose is to be served by such a
 Distribution? Nature gives us no more
 the Lymphatic & Arteries pass on, and
 there is proper for the purpose. In the
 extremities of the arteries a separation of certain
 parts of the Lymph from the red mass is
 necessary, but as soon as these parts have
 served their purpose of conveying nourishment
 & dispose, or of making secretions, We see no
 reason why the Lymph should not be
 immediately returned to the red Veins.
 And as the red Arteries divide into
 colour'd

coloured & colourless branches, why not suppose
 the veins begin in the same manner. If lymph
 is necessary near to the Heart to give the proper
 fluidity to the blood in the large vessels,
 surely a greater quantity is necessary in its
 return towards the Heart, and Nature
 must send as much as the necessities of
 things require; so we see an evident
 purpose why the red & colourless parts
 should be again blended together. Or let
 us reason in another way, let us examine
 any of those organs where there is a loss
 of the red colour in the body; Do we find
 the veins coming from these have any
 smaller proportion? They are equally
 large, and the lymphatics are by no
 means larger. May we may give instances
 where without doubt the lymph goes with the
 red veins, as in the Eye. In the Eye of a Child
 we find Arteries on the Crystalline Lens which

617. Convey red blood, and also afterwards these
become too small to admit the Globules, so
they not continue to send the humours in y^e
same way — It seems obvious what takes
place in Fishes, as in the cod or skate, who
have a few organs of a deep red colour, but
all the rest colourless; & when colourless
arteries return their contents by colourless
veins, the proportion of the red veins should
be very small, whereas we see the same
proportions offered in these animals as in
Man. So there is no purpose answered by
their being distinct in this course, but
every circumstance seems to show that
the colourless arteries as well as y^e colour
form the red veins; & hence the lymphatic
veins serve a different purpose of Assimilation.
But not to rest that Argument there,
Let us next weigh the sev^d proofs which
show

show the Lymphatic vessels to have no
 immediate connection with the Arterial
 System, but to begin with open Mouths.
 First, Surely You are struck wth the Analogy
 of the Ducts, which is complete in every
 circumstance. We find the same structure
 of their coats, which are thin, tough, & transparent.
 We find them both passing thro' glands, which
 agree perfectly whether we consider y^e shape
 colour, or Consistence, We find the vessels in
 a similar way passing along their surface
 & thro' them, and they have one common
 termination in the Thoracic Duct, so like
 the Ducts we must suppose they begin
 by open Mouths. Or let us consider the
 Valvular structure more particularly—
 Why has Nature crowded these vessels wth
 Valves, when so few are to be found in
 the

619. The Old Veins? In the Old Veins there is
a Vis a Tergo of the Heart & Arteries pushing
on the blood and a few Valves are quite
sufficient to determine the blood to the
Heart if a Muscle acts; but in the Lymphatic
Veins the push behind is wanting, so
more assistance is necessary, that every
the smallest pressure whether of a Muscle
or Artery may assist in driving the fluid
onwards. Or to give a practical proof of
the effect of the Valves. If I have injected
a Lymphatic with Mercury, I must take
care how I handle it, as the slightest touch
drives the Mercury beyond the next set
of Valves. As the Lymphatics therefore
are better fitted for taking the advantage
of the pressure of the neighbouring organs,
We are led to conceive that they need
this

This prepares more so They have a diff^t origin. Further, Let us attend to the Ducts of ye Glands, The Pancreatic or Salivary Duct, begins with branches as minute as the supposed beginning of the Lymphatics and yet They have no valves, because They have arteries a tergo to carry on the fluid.

Next, Let us see what happens in a Living Animal, and here I would appeal to those very Authors, who conceive that the Lymphatics come from the Arteries. They speak of them as continuing to be filled as long as a degree of Warmth & Contractibility continues in ye part, or as long as the Vessels continue to be filled, & the flow continues equal tho we lose the Artery. Next, I would observe the resemblance which the Liquors contained within them, have to those in the part from which They come

come. In most parts of the body there is such a sameness of fluids, that we cannot draw a very conclusive argument there, but I have examined this matter in the Liver, with very particular attention, and I alledge as a fact that the Bile of Animals passes in a sound state, but more readily when its ducts are obstructed, into the Lymphatic vessels, so as to give a colour, & a very strong taste to their contents. I without doubt the mouths of the Lymphatic vessels begin from the Cavities or recesses of the Bile.

To this we may add the many Observations which we can make in diff. Diseases & which it is very useful to attend to. That whenever acid matter, whether of Disease or Medicine is absorbed, there is a danger of swelling being produced in
the

The Lymphatic glands between it and the
Heart, not in those nearest it, but in those
which are in the way of the Lymphatics.
So if We apply a blister to the Neck, We do
not find the Lymphatic glands immediately
above the Blister swell, only those between
it & the Heart. In like manner if We apply
a Blister higher than the Infernal glands
these don't swell, but if we apply it to the
Foot they generally do, tho' not always,
some being more irritable than others.

So likewise We can trace the course of the
Venereal poison, in the common manner
in which Buboes are received. You will
find that all the Buboes You have seen
were at the upper part of the Ing. Cluster,
very near to the tendons of the Ext. Abiguo;
Yet the whole gland were equally near
to the place of infection, They all receive
the

the same Names & Circulating vessels, and
 We can only explain this by supposing
 That the Venereal poison is directly
 translated thro the Lymphatic vessels
 into these particular glands. I have in
 fact found it so on several subjects, &
 I have traced them from the Penis into
 the Upper part - I have traced them like
 threads under the finger running into, or
 very near the Inguinal glands. But if
 an irritation be applied lower than this
 Not the upper part of these glands, but
 the lowest of the Penis is affected. So if
 a Nurse receives the infection from a
 child at the Nipple, the glands of the
 Axilla swell, and in the manner
 Surgeons who happen to have a scratch
 on their finger have had the Axillary
 glands

Glands swell'd, from Depressing, or Depressing
 Nutritive Patients, and where the Child
 receives it by sucking the Mother, these of
 the Milk are affected. Also if a Cancer
 breeds in the Breast it always affects
 the glands of the same side. To this I
 may add a Variety of cases of Suppuration
 from less irritating causes for ordinary, as
 that of Scrophulae, where it takes place in
 the hand or foot, we find the glands swell'd
 in the Arm pit or Groin. May in Galen
 we have Histories of this kind, who calls
 the Glands when swell'd Putones, I have
 only one proof more to add, That when
 a strong smelling substance, as Camphor
 is applied to any part of an Animal I
 constantly find that the Lymph receives
 the taste from it. I avoid entirely what
 will

will appear still more clear instances of
 this which more than one Author has dis-
 = crited the Mouths of the Lymphatics as visible
 to the naked eye, as at the Sapient Gallinapenis
 whereby drawing into them they have
 filled them upward. Now without ever
 having made an experiment I sh^d reject
 such a supposition, for were this the case, Graft
 substances would enter our Lymph. system,
 that could not get thro' the Circulation,
 but would stop in the extremities of the
 Arteries. But I know the case to be this, when
 I have tried injecting the Mucous ducts of
 the Muckroo wth Mummy & Wax, these are very
 thin & tender, & they are lodged in a very loose
 cellular substance so that they readily
 burst & the liquor getting out at a hole in
 them runs irregularly in the cell. so. & as
 as it goes on, & at last gets into a branch of a
 l^{id} vein or Lymph. in a Testicle, by bruising
 we prevent forcing the Matter when in a Lymphatic.
 Lend

Let our last meeting I endeavour to prove
That the Arteries, so far as regards Circulation
correspond with the Veins, but wth regard to
Exhalation & Inhalation That the Lymphatic
Vessels agree with the Arteries. And if you
now recollect the places in which I attempted
to show you the Lymphatic glands, you will
conclude That They do this office universally.
You have seen a few Lymphatic glands
in the Neck, a large Cluster in the Groin which
receive the Lymphatics of the lower extremities.
Then We have found numerous Lymphatic
glands at the top of the Pelvis & back of the
Abdomen, over the Viscs; & say further I took
pains formerly to demonstrate these glands
adhering to every one of the Abd. Viscera.
Now from what you know of the structure
of the Lymphatic glands, the demonstration is

624. is the same as that of the Vessels themselves,
They are made chiefly by the passage of the
Lymphatics, receiving only branches from the
Arteries from their Nutrition; so wherever there
are Lymphatics we must suppose the existence
of Glands. Then tracing the Duct upwards
We found the Laryngeal Lymphatics on the
Esophagus others adhering to the Lungs, We
found others to the arm, In the Axilla We
found a large Cluster of such Glands, and in
many diseased persons I have seen small
ones placed upon the inner side of the bending
of the Arm as in Scrophulous cases. Then We
have seen Lymphatic Glands disposed in a
continued chain along the neck, so called
Glandulae fauciales. So that the only
organ concerning which a Doubt is entertained
is the Brain, and I apprehend this Doubt
is without the smallest Degree of foundation.

It proceeds on the single Circumstance, that ^{2nd}
no late very accurate Anatomist has demonstr'd
them, for there is mention made of them by
Mons. but we might deny them as well in
other places. Who has shown them within
the Bones? Yet in the case of Collections of
matters within these, the glands between the
parts discrib'd swell considerably of which
you will find instances in the Medical
Essays. Now with regard to the Lymphatics
of the Brain, it is just very difficult to trace
the branches of these vessels any where, &
there are but few Anatomists who have ever
examind the larger branches terminating in
the Thoracic Duct. We are far from having
tolerable Discriptions in many of the other
Organs, and it is chiefly by interrupting
their Course in living animals that we can
trace

629. trace them, which cannot at all be done in
the Brain, as the greater number will be
placed in the lower part of it. Next, the fine
proof of their existence by observing Morbid
Swellings in the glands of the neck in the
Case of Wounds & Suppurations of the Brain.
And this would happen more frequently, but
matter forms in the Brain without producing
very fatal Symptoms, so that the Disease can-
not make the necessary progress, so there is
not the smallest probability that the Brain
wants Lymphatics. Crystalline glands are
not found within the Cranium, as they wd
have been unsafe there, for being liable to Ab-
-straction they might have produced y^e most
unfavourable Symptoms. Key y^e Lymph^c
glands in the neck are as near to the Brain,
as the cluster in the Groin or Axilla is to
the hand or foot. And I would observe
further

630.
further, that the Glands of the Neck are
more numerous & larger than to correspond
with the Muscular organs & Skin of the Head
and Neck, so I would alludge that they serve
the Brain likewise. Nay further I find
them more numerous in Man, than in any
Animals where the Brain is smaller, and
I have no doubt that future experience will
prove that Lymphatics descend from the
Brain into the Glandulae Cervicales, that
there may be other terminations, or organs that
are Nervous, I make no doubt as the glands of
Pachioni which are glands of this system,
and which terminate perhaps in the Sigmoid
Sinus, & in the Veins. And the glands in
the Sella Turcica may transmit their
Lymph from the Ventricles of the Brain,
and the Infundibulum is beyond all
doubt a hollow tube — I find no kind of

631. of argument therefore for supposing that y^e
Brain is an exception, or that the process of
Nature is here inverted; and I wd conceive
that this Distribution of the Lymphatic System
is universal, that branches of it begin in
every part of the Body. —

The next point we are led to is, To determine
whether the Branches of the Arteries assist
in the office of Absorption? Whether whilst
we introduce this opinion we are to retain
the old one, that the Absorbent Branches
terminate in the Arteries? Perhaps we
have not Data to draw a certain conclusion
from, but we have Data sufficient to lead to
a probable one viz. That the whole office
of Absorption is performed by y^e Lymphatics,
and that the Arteries have no part in it.
There are however a Number of circumstances
here which ought to be weighed. It was
former-

692.

formerly alledged That the Lymphatics
were not known in many parts of y^e body,
But I have removed this objection, and this
Doubt of their being wanting in many parts
was the more readily assented to, as it was
the opinion of Anatomists That they were
wanting altogether in Viperous Animals,
but I have shown them in one of them viz.
the Turtle, and ⁱⁿ the comparative Anatomy
I shall give a further account of this, and
They are now known in all the Classes
of the larger Animals. Next, it was alledged
by Authors, & the fact is true, That when we
injected into a Vein which wants Valves, as
into one from the Intestines, That the Liquor
if it is a clear Mucus one passes from the
Vein into the Cavity of the Gut. But it
Does not follow from this That the Vein
has gone into a branch w^{ch} is really Venous
No, the Liquor passes into the Artery, and
goes

699. ~~Let~~ out at an Ethereal Artery, instead of an
Inferior Vein. But a strong Argument
yet remains N^y. That when Liquors which
are colour'd or strong scented have been
poured into the Cavities of Bodies, the colour or
Taste of these have been discovered in the
Veins. Now if the experiment is done in a
living Animal, I cannot pretend that the
Liquor has gone into the Artery & so back into
the Vein; but I obviate this by doubting
of the fact, tho' I don't pretend to give a clear
Confutation of it. Several have made Expts
of this kind, so Boerhaave alleged that
having poured Water into the Stomach, it
was seen in great quantity in the Mesenteric
Veins, but others have not observed this, tho'
scented Liquors had enter'd the Arteries, they
did not find them in the Mesenteric Veins.
Now, I wish'd to bring this to the Test
of

634.
of Experiment, but before I mention this I
must observe the following fact. We have
considered the Thoracic Duct as the general
communication of all the Lymphatics, Now if these
alone afford, and if We intercept the Communication
of the Thoracic Duct with the body, We prevent
the entrance of every kind of effused liquor
from those parts. That is a general principle
and the conclusion may be drawn with
an Absolute certainty, if the common Dis-
=position was Just That the Thoracic Duct
is the general communication of all the Lymphatics.
But from various Dispositions of every part
and of the Human body, I have found
occasionally various Communications wh
are not attended to, or known. Thus I have
traced a large Lymphatic of the Abdomen
into the Vein of the Capsula Renalis, and I
find in Animals That the Thoracic Duct
very

635. very frequently about the top of the Thoracic duct
into two branches which do not unite again
before they enter the Vein, but whilst the
general termination is in the meeting of the
Subclavian & Jugular veins, a small branch
will enter perhaps at an inch distance, Nor
is this all, But I have found in my Subjects
where I have tied up the whole top of the
Thoracic duct, that on blowing in Air, or on
Injecting Water at the Respiratory Cylinders,
the Air or Water got into branches of the Vena
Agglossa, so that we could be certain of
succeeding with our Experiments. However
cut off the Thoracic duct in a living
Animal, I gave it Madder mixed with its
Common food, expecting that it would be
impossible to communicate the tinge of the
matter to the Bones, or to Mow the animal
at all. Now by repeating experiments of
this kind without cutting the Thoracic duct

I had discovered that in a young animal ^{606.}
the Nerve was evidently communicated to
the bones particularly to the Os Frontis, and
in one Animal which lived about 80 hours
after being the Diet, and which eat very
freedily of the food, there was not the slightest
tinge, tho' on cutting the Nerves and Glands
I found the Matter in the whole tract of the
Alimentary Canal. I was prevented however
from satisfying myself fully, by all the
other Animals dying in an unexpected way.
In the Thoracic Diet, where it is about to
take its turn upon the principle Nerves of
the body on which Life depends, and tho'
I avoided every visible branch of the Indurated
or 8th Pair of Nerves, yet by exposing the
Heart to the air, and by cutting a few
very small branches, an Inflammation
came on, & they died in a space that
was too short to determine the effects of the

634. The Maddox. So I must need an Experiment
which would take a short time. Having
just opened the Thoracic Duct, I applied
Camphor under the Skin, between the
Muscles, and put it into the Cavity of y^e Wound
and in less than an Hour the Taste of the
Camphor was very strong in the contents of
the Duct, it was absorbed in great quantity &
the taste was Manifest. Now I was in
expectation that the Taste would not be
communicated to the red blood, and I was
sensible that it was by no means communi-
cated so soon, but at length I found that the
Red blood also had received its share. I
leave that fact to be determined by future
experiments. The conclusions from it are
one of these three viz. That the Camphor
is only taken in by the Lymphatics, but
that these have other than the known
communications with the red veins, that

638.
That branches of the Lymphatics in their
Course from the Abdomen upwards com-
=unicate with the Vena Azygos, or some other
Vein, so convey the matter in that way, Or
That the Red Veins have absorbing branches,
Or Lastly, That the Camphor being a very
Volatile & penetrating substance passes thro'
the pores of the parts and so communicates
its taste. And I much disposed to believe
That the last is one way of explaining the
fact. For having fast tied the Thoracic
Duct & put it above the ligature, I squinted
into the Rectum a Solution of Camphor &
tyed it up, and after a few minutes, on
cutting open the Cavity of the Abdomen I
was immediately struck with the smell
of the Camphor which had passed at
once independent of Absorption & Circulation
thro' all the membranes of the Animal.

do

639. So that upon the whole I can't yet pretend
to say that there are no afferent branches of
Veins, but I think the opinion is improbable
at least so far as respects the common liquors
of animals, & especially such as can nourish
the body, and I doubt if we can feed any
Animal if we interrupt the communications
of the Thoracic Duct, which is an experiment
I will pursue. I have opened that Canal
in different places without opening the
Cavity of the Abdomen, but still by Judicious
Stitches kept so close so that Canal that it
endangers the Life of the Animal —
I have said nothing of some of my Arguments
about the Veins afferent, as some experiment
which have been proposed lately by Doctor
Macle, because I know certainly that we
have been particularly unlucky in every
circumstance, & mistaken in what we
ancient

Denies as well as in what He affirms, ^{Letter.}
and granting His facts, the application He
makes is by no means Crivisant. No,
one excepted, I have made every Experiment
He mentions, many years ago. — So I am
able to fill Veins by blowing air forcibly, or
by squinting liquors into Veinlets. I showed
You an example of this, M. as by blowing into
the Pelvis of the Kidney, the vein of 4th Kidney
was immediately filled, and last year when
blowing into the Vesica Miliaria, the Air
entered the Vena Cava, it had got in by some
of the Mucous ducts to the cellular substance
between it, and also Branches of the Veins, and
so got into the Cava. — Now the same thing
happens in any other organ, so by blowing
air into the Miliary ducts, I have filled
the Vena Porta, or Vena Cava, and I have
Done

161. Done the same thing with injections even
of the coarse kind, But this succeeds best
where the subject is already in a Tumor
state, & when force is used. In short the
experiments are the same where we fill
the Lymphatics by injecting into Arteries
& Veins when we burst them. Nay attend
to Dr. Meckel's exper^t of the Mamma, where
he alleges that the Quicksilver which has
made its way from the Lactiferous ducts
into the Cellular substance, must have
first entered the Veins, burst these, and so
got into the Cellular substance. Now the
Mamma was cut from the body, and it
was not in his power to stretch the parts,
but the Cellular substance was here, and the
Mercury got into Lacerated Veins by holes
made in their side. In the manner
in the Glandular glands, He describes
Veins

Veins beginning from these, because He fills ^{642.}
them by injecting Lymphatic vessels. Now
You will observe first, That Michle has made
His experiment on a diseased gland, where it
was schirous & nodded, and yet from this
We are to conclude with regard to its found
structure. Further, He does not know
That the Lymphatic glands have Cells
within them, nor has He observed the appearance
of the Follicles of the Mammas. His injections
do not penetrate so far as to show these, and
He thought He had reached the beginning of
the venous Alfortments. And after all are
We to take for granted That the beginning
of these vessels can be shown in that way?
Why does He not inject them from the seral
cavities with equal ease. In short all
His experiments in proof That the Branches
of Veins alfort, are founded upon Mistake.
Next,

643. Next, suppose this Data just, let us see how
He applies them. He tells us if Campther
Dissolved in oil be applied to the surface
of the Breast, it may go into the places where
the Milk is lodged & Dissolve obstructions there,
and that by passing into those Veins which
He supposes to come from the Cavities of the
Breast, which is applying here what I meant
of the possibility of Dissolving obstructions
in the Conglobate gland, by matter taken
in by the Lymphatics. For a matter of any
kind taken in by a Lymphatic may
reach a Conglobate gland in its Course
towards the Heart, but it cannot go back
to the origin of that or any other Lymph.

After attempting to determine that the
Lymphatics perform Absorption, perhaps before
proceeding further it may be necessary to
give an explanation of the manner in
which the fluid is carried from the beginning of

of the Symplicatics forward to the Heart — ^{644.}
We want the Vit a Morgagni, How then do
Liquors get into the Lactals or Symplicatics?
Physicians are very apt to conceive that as the
Gutts are contractile organs, the food by the
contraction is driven into the Lactals; but
it enters where the quantity is so small as
not to suffer any degree of pressure from the
Gutts, and we find the liquor entering the
Symplicatic system where Muscular pressure
is altogether wanting. So we are to conceive
with the more accurate Physiologists that
Liquors are sucked in as by the roots of plants,
or that they enter in the way where liquors
enter thro' small tubes called Capillary. So
if we make small tubes of glass and dip
them into a Cistern containing Water, it is
found that the Water rises within the tube
higher than its surface, and the height of
its ascent is in proportion to the smallness of

615.
of the tubes. I do not pretend to determine
the power which raises the Water, nor perhaps
is that very well explained to us, but we see
the fact, which is all we need. Now let us
apply this to our Arterient Vessels, Liquors
enter a certain way in them. They are sucked
in, or we shall call it attracted, but this
power can only begin a motion, for after a
certain length the liquor stops, so the liquor
entering thus so far, it is afterwards promoted
by receiving an impulse to push it on to
the Heart, which is chiefly given by the force
of the Vessels, for however thin they are, yet
they are beyond all doubt Muscular. Just
as we see a most perfectly transparent and
not possessing Muscles wth contractile power,
so we are not to fence the red colour and
Contractile power as being inseparable.
Our Iris has as ready motions as any organ
called Muscular, and after the Death of the

646.
The Animal, The Sympathetic System never
fails to employ itself very completely— Most,
I think we must suppose that contraction
is made in the way that is safest is that
it begins at the very orifice of the Vessels, &
I have no manner of doubt that independent
of Valves within these vessels they would be
capable of sucking in fluids, but that there
may not be interrupted by the pressure,
and to make the passage more ready, Valves
are added even at their very beginning—

Dr Haller is mistaken in supposing that
the Lacteals have only Valves after they
enter the Mesentary, for we find them
even on the outside of the Villous Coat,
so that I find it impossible to reject the
theory of the Guttur from this place of the
Lacteals— Not supposing only a gentle
motion of the Vessels, the Valves determine
the

647. The Liquor to the Heart, and from its course
assistance is given by the Muscles, so by
every moving power they meet with. The
principle Vents, accompany the Arteries
and every stroke must drive the Lymph
mechanically forward to the Heart. In
like manner the Thoracic Duct runs parallel
to the Aorta, and we find here fewer valves
than in the smaller branches which only
cross over the Arteries. Joining these Circumstances
together we find no difficulty in conceiving
how the absorbed Liquors are carried on
without the Vitæ a Mergo —

Next, after knowing the office of Lymphatics
we wd wish to have some idea of the
purposes they are made to serve, and
some of these are very evident.

The Radicals taken in our Nourishment, &
this will in some measure apply to the

The Lymphatics, started up to this coming
 from the Lungs, for I shall give reasons
 for thinking that whilst We throw out a
 poisonous matter from the Lungs, We probably
 at the same time take in a somewhat
 useful to Life from the air. Next, They
 prevent the acrid fluids of the body from
 becoming dropical, or the exhaled liquors
 from turning acid by stagnation. They
 also serve for the preparation of the acrid
 secreted liquors, as the Mucus, the Semen,
 the Urine &c. These need to be diluted by
 thin liquors that they may be carried
 thro' the very small vessels, but these thin
 diluting liquors, after the separation not
 only become useful, but are hurtful, and
 while the Lymphatics carry off the more
 Watery parts, They are of general use to
 our Economy. We do not see this fully
 if

619. if we suppose with Haller and others that
Secretion is merely a separation of one part
of the blood from another. But there is not
only a separation of this kind, but a change
made, or new substances created, some of
which are usefull when reasumed. So
there is a difference between the flesh of the
Bull, and that of the Goat, and the female
may by influencing the Nerves of organs
of Generation have some effect, That factor
which has been taken notice of, is chiefly
produced by the Absorption of its parts, and
the changes made in different organs are
in a great measure owing to this. Nay in
Fishes there is a Sexia Marina, the Nerves
do not end at the surface and discharge
the fluid into the sea, but it is deposited
in a receptacle, probably, that somewhat
may be taken back which is usefull
to

to the animal economy. And Lastly We
 have observed that the Lymph is carefully
 united with the Chyle, before it reaches the
 Mass of blood, and this I take to be a matter
 of the utmost consequence. For it is in vain
 to conceive that the Chyle falls into the
 veins drop by drop, or to imagine that we
 cannot perceive it at all in the mass of blood.
 When an animal eats the more selected
 kinds of food, a very great quantity flows
 thro' the duct in a few minutes, and with
 the naked eye we can see that the parts
 are imperfectly mixed; We can distinguish
 oily globules floating on the surface, and on
 opening a large vessel, I am very often
 perceive the Chyle swimming on the
 surface of the blood. Now if we see that
 after all the Mixture the Chyle undergoes,
 the Union is still imperfect without
 the

651. The connection of the Lachryal & Lymphatic Systems, before it enters the blood dangerous consequences might have been produced; this connection is therefore made, so far as is consistent with safety —

Lect. 50th

I show you a preparation where the Membrane glands are affected, and we find in them a cheesy like matter. In many cases they are said to be ossified, or we find a calcareous matter in them which becomes very hard & puts on the appearance of Bone.

I have now not only shown the structure and the course of the Lymphatic Vessel, but attempted to prove that they perform absorption universally in the body, and I have shown the many reasons which render us to a doubt the opinion of the Medical Writers branching as they are in this office —

Sincerely

Surely if a single Ethalut Artery cannot
 only make the separation of the parts of the
 blood, but change these, the mere taking in
 these fluids must be an easier operation,
 and there is no necessity that an Ethalut
 should have two vessels corresponding to
 it which belong to different Systems.

I might perhaps add another argument
 against this opinion, that I have seen
 sev^l cases, where in consequence of a swelling
 of the Axillary glands from a Cancer of the
 Breast, the whole arm was Paralytic
 for a long time. Now if the red veins in
 any remarkable degree perform Absorption
 sev^l of these humours under the Axilla, but
 the Cephalic veins between the Pectoral &
Deltoid muscles free from the compression
 of the Axillary glands, so the Lymph by these
 might have returned to the mass of blood.

and

653. and from this we may take it for granted
That the Lymphatics alone perform Absorption.

Then proceed to point out the general
applicⁿ of this doctrine in our Physiology, and
still more in the Practice of Physic & Surgery.

I would begin with observing that, in practice
in many cases will be materially influenced
by our conceiving that Absorption is performed
by Valvular vessels, because we see the
possibility of affecting the motion of fluids in
these by mechanical means, as they are
fitted for taking the advantage of External
pressure; every motion of a muscle, every
Pulsation of an Artery drives the Liquors they
surround of Valves, so allows the Lymph to
enter more readily from the smaller branches,
empties these, and prepares them for the
reception of more liquor. So in Diseases where
there are effusions into y^e sero-fibrous, gland
ad=

654.
Advantage may be reap'd from exercise
and friction. To open Veins downwards
Physicians speak much of the effect of
rubbing oil on the belly in cases of Aortitis.
And in Dropsical cases in general. We often
perceive Patients taking best & a horizontal
posture, and encouraged in it, because when
the body is erect the limbs swell, when the
force is increased in the Exhalant vessels, &
the matter more difficultly returns, but
this ought not to ballance the advantages
that might arise from friction & Motion
which are very essential in the cure of
most Dropsies. Next, we shall observe
That very different opinions may be enter-
tain'd concerning the way in wh. certain
changes are operat'd in our bowels.
So we find Authors speaking of the great
Difference which may be depending blood
on

655. on the Left side of the Heart, from the Right,
and they inscribe this to somewhat added
thru the Pulmonary Veins to the blood on the
Left side; whereas the Lymphatics of the lungs
end in the Thoracic Duct, so that whatever is
received, passes to the Right side as well as
to the Left, so we must find a different
explanation of the change of blood undergoes.
In the manner in speaking of the section
of the bile, we seem to find great assistance
in Bowdloke & Haller for explaining it,
That certain parts are supplied, as oil from
the Intestines, & portions of the bile itself from
the Alimentary Canal; but the Effluents
of these organs pass upwards into the
Mass, so that the whole change is operated
in the Vena Portarum, without any such
addition being made. Let us next
attend

attend to the Morbid changes which may ^{take}
be produced, and first we perceive that
almost all our Lymphatic vessels in their
way to the Thorax pass thro' certain glands
in which there is a minute Division first
into Branches, & afterwards a Deposition of
the Liquor into Cells, thence we perceive
that these glands may be very much laid
open to Disease; & the matter taken in
may stop in the Division of the Vessels, or in
the Cells, and in fact this happens most
frequently where very acid & gross matter
is received into the Radical part of the system,
so I have drawn a cheesy, or Opacous matter in
the Mesenteric glands. Now, You will
observe that the whole of the Lymphatics
do not divide on these glands, but when
one enters the Gland, another passes over
it, & the same thing is done with the meeting
of

657. of the secret Glands, and so on to their
termination. Hence you observe that a
mere affection of a single gland does not
prevent the absorption, or the flow of the
Absorbed liquors from all the parts under it
from which the Lymphatics begin. I have
Repeatedly seen a very great number of y^e
Mammary glands, in these places from the
Groin upwards & downwards, & yet I could make
an injection go up towards the Head without
affording any oedematous swelling in the
Extremities. Swellings take place only where
large clusters are affected, & very little room
is given for the liquor being transmitted by
the vessels on the surface. As when the
Cluster of the Axilla is affected the whole
arm is swelled. An attention to this
circumstance is necessary in order to give
us proper Caution in treating many
Cents.

Contagious Diseases, or where matter is ^{let 8.}
taken in that afterwards taints the blood
Of a Bubo happens in the common manner
Many Authors seem to imagine that it is
of the utmost consequence to bring that to
Suppuration, because the Venereal Virus is
thereby thrown out of the body - Now in
fact it seems sometimes to happen that the
Patient does not suffer any after infection
tho he has taken little or no medicine, but
from the Lymphatic passing over the glands.
You perceive the possibility of the taint being
communicated without any Bubo. Next,
supposing it to form completely so as quite
to obstruct the gland, another portion may
pass over the surface of that gland to the
Mass of blood, so that the cure in many
such cases cannot be cured without the use
of

659. of the proper antidote. Pursuing this view
We see the further danger of Buboes forming
higher than the common place; This is an
evil which has been often look'd for, but I
do not know that it was ever found. Were
Buboes to happen within the Belly, and a
Suppuration to take place the consequences
might be highly dangerous or fatal, but
this is prevented by the whole Sympth of
the same extremities being added, w^h divides
the Matter, and renders it less irritating and
less capable of Afflicting the Higher parts.
Next, I have observ'd that a swelling of these
glands, gives the indication of a translocation
of Morbid matter, and hence in a variety
of instances we judge of the manner in
which our bodies are affected, as when
Cauteries are applied to the surface,
the Diff. Glands of Conglobate glands may
be

be affected, and on this account it may be
impracticable to keep open a perpetual
issue; and in some cases they have pro-
-uced the appearance of the Disease for which
they were applied. The Patient was thought
to have got the scrophulous appearance in
the Osella, whereas it was produced by
the Blister or Issue between the Shoulders
applied for a slight complaint perhaps.
Now we perceive further from this account
that there is a real entrance of such
into our Mass of blood, and not after
Symptoms as the Strangury are owing to
the particles of the Cantharides conveyed
into the urinary organs & irritating them;
and are not to be considered as an Affn
of the A. S. so instead of being able to re-
-move these by Emollient Poultices, we
must delete the particles of the Cantharides
by

161. by large quantities of Water. Or when these
effects are produced by Cantharides, I have
found that we can continue the Issue
in the common way, by dropping with
Caustic mixed with oil, at 3i of Caustic
to 3x of common Basilicon, which makes
an ointment that keeps up a perpetual
discharge without hurting the Symplicities,
to occasion swellings in the glands.

Next, We judge of the sameness of Disease,
when we may perceive there are real
Differences. Thus some few, of late years,
have conceived that the Gonorrhoea and
Confused Scurf, proceed from different
Causes, whereas Buboes are produced in
the same manner by both, from which
circumstances we exclude the matter
to be one. Next, We form just opinions
of the Nature of Tumours; We conjecture
from

from the appearance of the Lymphatic glands
whether the humour remains in an unactive
state, or that acid matter is formed within it
which is a Circumstance very much considered
As suppose a Woman to have a Schirous
in the Breast, if I observe a gland swelled
in the Axilla, I may conclude wth affluence
certainly that a Cancer has begun, this is
so far from being properly attended to that
Morison in the cases he has published under
the eye of Van Swieten, has not distinguished
between the Schirous & Cancerous states of
the Mamma, and at least one half of 4
Schirri he mentions were Cancerous. so
the cures are more important than they
seem to have conceived, supposing a just
narration given of all the diff^t circumstances.
and we constantly trace the course of the
swelling in the very course the Lymph takes,
J

669. I am enabled from that circumstance to
Judge whether the Disease is in its progress
inwards, or whether it is thrown outwards
from the Mass of blood. If We observe for
example a Pustule, contracted in the common
way, near to the bottom of the Uterus
we conclude that the matter is only on its
passage towards the blood. If again We
should ever find that a gland as is under
part of the Infernal Gland or swells out,
or that the Lymphatic glands & glands are
affected in the Naila, or behind the Ear,
We conclude that the Mass of blood has
been tainted and the matter is thrown
out on particular parts; as when it is
concentrated, and forms Abscesses in Abscess.
By attending to such swellings, We can
next give Proof that the matter of Diseases
is more more penetrating than many
have

have conceived it to be. it is allowed ^{1664.}
That many Diseases can enter the body by
the softer parts of the Skin, whilst it is believ'd
That the harder parts absolutely retain it, but
this seems doubtful, as I have been told
of several cases where the Variolous matter could
enter thro' the hardest part of the Skin. So
we are inform'd by Mr. Aulrey in his history
of St. Kilda that it is a practice to inoculate
the Children there, by tying a Thread dip'd in
Variolous matter round the Wrist, & what
proves that it really enter'd at the part, he
mentions his having seen several Children who
had boils & Suppurations in the Arm Pitt.
and I have been told of a similar case
where the Variolous matter being rubb'd
on the Skin, a little below the axilla, and
there was a large swelling in the Arm
just of that side, so that the matter must
have

665. have entered by the Mouths of the Lymphatic
Sympathetic. Nay the Venereal Poison
can also enter thro' the Pores of the Skin,
or by the mouths of the Lymphatics in the
Glands Penis & Prostate, tho' in general
there is first an erosion, or a breaking of
the Skin in 49 cases out of 50, before a
Bubo takes place. But in some cases
there is no running or appearance of Ulcer, and
yet a Bubo is formed. I would require many
cases to determine this point wth Certainty, but
this is the most common idea; and Gallopius
observes that in this time "Solet oriri Bubo
sine Gonorrhoea & sive foris" without either
Gonorrhoea or Chancre. Nay further in the
Plague, the most huminous of all Contagious
Diseases, We have reason to presume that
the Contagion actually enters the Pores of y^e
Skin almost every where; or you will find
that

About the Cervical Bubo frequently appears before the Patient sickens, and these kinds of swellings are more frequent in the upper parts of the body, which are exposed to the air, so that it would appear to be prudent by proper coverings to defend the Skin against the application of the matter to it.

Now, as we are taught to trace the progress of the Disease, so we are led to lessen the Danger, or to remove it altogether. Thus in the inoculation for the Small Pox, one Danger among many others is removed, or made less, by the passage which the inoculated matter takes to the Mass of Blood. If the infection is received in the natural way, the Lungs are loaded with it, and the matter may not only affect these with first contact, but by being absorbed from them, it may stop in the Bronchial glands, & the consequence may be fatal; whereas from the situation of the lymphatic glands

667. I am it is with more safety and readiness
discharged. The considⁿ of that circumstance led
me to propose in the treatise I published on the
Lymphatics, the inoculation for the Measles, which
more especially affect the Lungs, in so much that
the Cough is a pathognomonic sign of the Disease.
but we have not yet hit upon the proper method
of conveying the matter: Dr. Jenner made some
experiments, but the trials have not been yet
sufficiently repeated, tho' I still think as I did then,
that the infection would be best communicated
by applying a substance that imbibes the efflu-
-ence of the skin, as cotton, as we would
readily collect the matter in a more concentrated
state than it is in the blood. Next, we perceive
that the Tumours which form in the Lymphatic
glands are of the same nature generally with
those diseases which form them, so when the
Axillary glands are swelled from a skin
or

or Cancer, we are not able to distinguish the one
from the other either in colour or Consistence. So
we are not to conceive that this swelling depends
on a flux of humours to the part diseased, and
that the neighbouring glands swell by an acid
consequence, but we are to attend to a direct
translation of matter. So if the Surgeon hazards
an operation for a large Cancer of the Breast, We
must take out the Axillary glands as well as the
obscure Mamma, & must by no means trust
to their subsiding Naturally, which has often
deceived Surgeons not reflecting that y^e gland
pours out its poison directly into the blood.
Whilst however I speak of the necessity of this
operation, let us remember the vessels passing
on the surface of the glands, and not promise
that we shall fully interrupt the acid matter,
We only do so much to prevent the fluid
from

669. from being communicated, and Mean to make
the Prognosis accordingly, That the Disease is in
DANGER of returning tho' the chance of Life is
better perhaps in that method than in any other.
But it frequently happens that tho' a Cancer has
begun in the Mamma & there has been an Effusion
so that the Axillary gland swells, yet this swelling
is not to be discovered by the feel from the sound
Argument, the glands being buried in fat, and
the situation variable in several cases; yet we
may conclude that the Disease has made
this kind of progress, from observing an oedematous
swelling continued to the skin of the Breast,
occasioned by the obstruction of the glands; and
when the extent of the induration is still
greater, I have known the Dema continued
to the arm, and this likewise shows that
the matter is of a very acrid nature; for as
in the Venereal Disease it almost never happens
that

That Buboes form higher than the grain, so 670.
here, notwithstanding the Delusion from the
Lymphatics of the arm, not till the swellings
are formed, which convinces us of the acrimonious
Nature of the matter.

Next, You perceive that not only in swellings of
the Lymphatic glands We have it in our power
to treat these by surgical operations, but from
the very Nature of the Lymphatic vessels and
their office, we have it in our power to determine
the course of Medicines into the diseased part, &
I have no doubt but that this will be found
of real consequence, tho at present it seems to be
too much overlooked. Practitioners have been
in the method of rubbing Mercurial ointment
on Buboes, but this application will have little
effect, tho' if We apply it lower, so as to direct
it into the glands. With regard to the effect of Mercury
any way Topically applied, I do not find it
yet

671. not fully determined. And nothing can be determined
more easily as when several sores are produced at
once in the same Patient. Now I do not find in
any Author a clear proof that the application of
Mercury to such sores, heals them sooner, or that
the outward application has any influence
but by the Mercury entering the general mass.

But while we are giving a Patient a course
of Mercurial pills, when he has two sores, we
may dress the one with Mercurial ointment, and
the other with any common application. Now
this will apply universally to every other
disease placed in the lymphatic glands, as in
Scrophulous cases, where if the Sp. M. Mercurii
for instance has any influence as a discutient,
it will have more effect in the course of the
Lymphatics than by giving it in any other
way; and in fact in all evils of this kind
we ought to have this circumstance in view.

672.

If a disease forms in the Lungs, besides the
Dangers from the Structure of that organ, &
the importance of its functions; reflecting on the
course of the Lymphatics we see further Diffi-
-culties in curing it, for whenever Matter is
afforded it returns to the Right side of the Heart
and may be discharged by the common Vessel,
without ever returning to the diseased organ.
But in the Lungs it passes in a continued
circle, returns again to the Lungs, falling on
the diseased parts, which has its influence in
a certain degree.

The several circumstances I have mentioned
would admit of a more particular application
than I have thought necessary to specify,
and for which I must refer you to the
Small Treatise I have mentioned &—

Lect.

673.

Lect. 31th

With regard to the Affluent System, it only remains to determine How far the effect of Meds on the matter of Disease have upon the body, which depends on these being received & circulated with the blood, & How far they influence the body immediately thro' the Nerves to which they are primarily applied, and by Sympathy the rest of the Nervous System. But I find it better to delay this enquiry till we have first seen all the Nerves.

We next, therefore have the Arteries from the Heart, beginning with the Aorta, & its ascending Branches which run to the head. And I am more particularly at this meeting to shew the Vessels & Nerves of the surface of the Cranium; as they come just in our way, and to show at the same time the structure of the Segments so far as any thing remains on that subject.

The

The Segments of our body are connected to 674.
the parts underneath in the same way these
are joined to each other i.e. by cellular substance,
so that perhaps this Cellular Membrane ought
not to be mentioned as a part proper to the
Segments as one of the lamellae composing these;
This substance as we see on pulling up skin
is possessed of properties which adapt it for its
office. I can stretch it to a great degree without
giving pain, we give pain only when we
hit upon a Nerve which conducts a nerve to
the skin, but the Cellular Membrane of itself
seems insensible, so after the skin is divided
you may put a lancet under it, and cut ye
Cellular substance without the Patient
feeling you. Next, it possesses a considerable
degree of Elasticity, and hence as soon as
we cease from drawing the skin, it pulls
it back to its place. Then it allows of a
free

675. free communication among its cells, and the
Threads of it are matted together, and connected
to give additional strength to the inner part
of the Ligaments, or according to Haller, The
common Ligaments are in a great measure
composed of the felt membrane condensed;
for upon tracing it outwards we observe its
fibrils approaching closer, matted together and
running irregularly in diff^t directions, as is
evident in the Threads of a Glue - Next, You
Remember that in most places of the body
there is connected with this Membrane a
fatty matter, or Tunica Adiposa; Many have
conceived that the fat is deposited into the
common cellular membrane, and that it
remains in certain places from a solidity
of its parts; but other Anatomists have with
more reason conceived that the fatty and
cellular matter are distinct, so that in
certain places of the body, as in the prothurn
and

and in a great measure on the Pore Head, the ^{676.}
cellular substance is found in great abundance
but without the Adipose. Or we find the
same thing in the connection of the Muscular
to the Villous coat of the Intestines; and hence
they have conceived that the fat is poured into
certain bags or receptacles, and this opinion
I know to be altogether just. I am not sure
that any Author has put the matter to the
test of Experiment by the Microscope, but
when this is done I find the fat in every
part divided into minute globules, & among
the Membranes containing it branches of
Vessels I suspect. So without doubt there
are Adipose follicles, or shut bags wh^{ch} contain
the oil. And if Authors had reflected that
the oil can't be conveyed by the Arterial
vessels into the cells in the condensed state
in which we find it, they would have
perceived that ~~they~~^{it} could not be confined
by

67th.

by the Common cellular substance, but
the adipose follicles are open to it without
communicating. And where there is Anasarca
We find the adipose cells fill'd with the
fat, which is not in the same bag with
the Water. The Fat serves a variety of
purposes, many of which are abundantly
evident; It fills up the interstices of parts,
gives a more equal support; it serves to
lubricate the interior parts, so the Mucum
renders slippery the surface of the Abdomen
and Bowels. And hence we infer that w^t
regard to fat, there is a porous passage, an
exudation. We must allow this, for when
We examine the Mucum w^t a Microscope,
it is the same as the subcutaneous cells; so
we would infer, that the fat which is so
plentifully distributed under the skin,
may pass thro' the pores of it in like manner.
There is too a constant change of the parts
of

of the fat as well as of all other liquors, and 678.
as it is chiefly caused by exercise, we conclude
That the fat taken in by the Afforbents, and
returned to the genl mass is of particular use
to the body in that situation, in preventing
perhaps Acrimony, as the Salts of the body by
exercise are more exalted. Thus the Urine
becomes more acrid independent of the Dis-
-persions of its watery parts by exercise; and
I think, as we find by experience that Chilly
matter is particularly nourishing in so
much that a Gentleman lived several months
on Suet & Water; We must surely draw the
same conclusion from it reasorbed from the
Adipose cells. And where the Afforption is
in too great quantity, we explain it as appear-
-ing of the blood of the Serum becoming whitish;
for if the Aliment gives the Whiteness, We see
on killing a Starved Animal the fat
mixed

679. mixed with the Watery parts of the blood may
give the same appearance.

Now, the Hairs are rooted in the feet, & grounded
with it; When we examine the root of a
Hair accurately, we find it implanted in a
Bulb, or there is an appearance of two bulbs
filled with an unctuous kind of matter which
gives the colour to the Hair, the constituent
parts of which seem to be the same in all;
So from the Bulb this matter passes along the
Hair, but we do not exactly know the
manner of this passage, whether it is sucked
in, as in capillary tubes, or squeezed in from
the Bulb. But from this circumstance we
explain the change of colour which the Hair
undergoes, as it depends on the colouring matter,
a small attraction in the Bulb has this effect.
So if the Bulb shrinks the Hair loses its colour
and becomes white, and this accompanies the
the

680

The loss of fat in the body, as in Consumption cases, and in other cases the connection of the Hair is at the same time loosened. When the whole the bulbs of the Hair is a very frequent seat of disease, which we often suppose of the Skin, but which are placed deeper. So many eruptions & Eruptions which chiefly affect the parts where the Hairs are rooted, & here the cutting out the hair, that the Bulb may discharge itself, & the applied is a very reasonable practice.

Next, placed under the Skin we find certain Glands, or Ducts, which penetrate thro' it, and perhaps there may be organs of the same Nature dispersed every where, but the Glands separating an oily matter are found where the parts are exposed to friction or to the air. The Skin itself is ⁱⁿ a great measure composed of

of threads of cellular Membrane matted together irregularly, but with the addition of a vast number of Vessels conveying red blood as far as the surface of the skin, & the number varying in different parts, makes a certain variety in its colour. Along with the Vessels, Nerves are dispersed, & in certain places we find a most beautiful Distribution, as in the end of the Fingers & Toes, where we observe ridges, and in each of these we see an appearance of pits, which come to be filled with a watery liquor on pressing the fingers. When examined still more minutely we observe that they are cut across into parts, to which Authors have applied the name of Papillae, borrowing the term from the Tongue; but we are not certain that when we mean to feel accurately, these are filled, as is the case with the Papillae of

of the tongue. —

At the surface of the skin the vessels either
 terminate, as many suppose, or they are sud-
 -denly divided into very minute parts. & the
 remaining covering from the Cuticle is by
Macle & Haller supposed to be a mucus thrown
 out from the extremities of vessels, and hardened
 by the air on the surface. But all circumstances
 considered, we are rather to view the Nature of
 the Cuticle in a very different way, as an
 Organic substance, but the parts to minute
 to be demonstrated. For when we make a
 Dissection of it, & attempt to raise the one skin
 from the other, we find minute threads making
 the connection which are vascular, as when
 we raise the Periosteum from the Bone, &
 it is found in the most early period of the
 Foetus, while it yet floats in Water, & there
 is no external cause to give a hardness,
 may

689. Now, in the Intestines there is the same sandy
of thickness; add to this, that upon the ridges
one may see even with the naked eye a
number of hollow places, & upon pressing the
finger ~~the~~ you see the water enter regularly
into these, which is very different from a mass
hardening upon the surface. We thus pursue
the Ligaments from the Ethmoid parts into
the Intestinal, as when they cover ^{the} inside
of the lips, down the Noma & Alimentary
Canal, and these authors, as Haller, have
for granted that the Ethmoid arteries of the
Gutts open freely into the Cavities of the
Intestines. So upon the whole I conclude
with regard to the Eth. Vessels that it is
found they are continuations of the Blood vessels
into it, and in Bladders the water collecting
is not to be explained, that it is discharged
in

in such quantity as not to pass thro' the
 Pores, but the Water in a Blister is totally
 different from that which is excreted, there
 is an Inflammⁿ produced, and an Effusion
 of the Lymphatic part of the blood, which with
 the Serum makes the Water of the Blister, and
 there is perhaps a bursting of Vessels, and a
 real Effusion. We see too, That after the Cuticle
 is separated it is suddenly regenerated, wh^{ch}
 may be owing to the production of new
 of the Vessels of the Skin. That the Cuticle is
 in a constant state of change is highly
 probable, or That the parts are falling off
 and others form'd underneath. The Nails
 are in effect part of the Cuticle, and in them
 we observe a regular organization, the fibres
 advancing by slow degrees, as where there
 are marks which may take months to
 come from the bottom of the Nail to the

Ex-

685. Extremity. We see in the Cuticle ^{the appearance}
of a double Membrane, or a Corpus Mucosum
within the Ethereal membrane.

With regard to the uses of the Skin, By its
Sensibility we are forced to avoid injuries
Done to the body, while by its Thickness it
affords a covering to the Internal organs.

By the Division of the Vessels upon it,
somewhat it is separated from the body, which
in Warm Females exceeds in quantity the
Urine, and in our own is nearly equal
to it; and while we consider the Ethalam
Letus taken in to account, that somewhat
which is continually absorbed from the
Atmosphere, particularly in the Sleep;
and as the body loses of weight by sweat,
so at other times the Inhalation may
exceed the quantity Discharged, as when
the flow of urine is found to exceed the
quant=

quantity of Breath taken in without any waste of the body. The Cuticle of the Inferior parts, confines very powerfully the Juices of the body; So Anatomists find that if any part of the Cuticle has been rubb'd off a subject, that part of the body dries much sooner than the rest. It is very dense has very few pores, and resists Putrefaction so much, that in Mortifications the Cuticle generally remains entire.

Lect. 52^{do}

Having now seen the Structure of the Containing parts, we proceed to examine the Contents of the Brain viz^t The vessels of ye Membranes, & Substance of the Brain and Cerebellum; and with these I'll demonstrate the Spinal Marrow in order to have before us at one View the whole origin of the Nerves. — Lect.

You have now seen fully the Vessels, and the manner of Circulation at the origin of the Nervous System; and tho' this is not so singular as Physiologists in general endeavour to persuade You, yet many circumstances well merit Your attention —

First. Surely You have all remarked that a very great proportion of the Mass of blood is sent thence; Dr Haller endeavours to point out that to You, but in one medical circumstance he has committed an oversight, by comparing the Arteries of the Brain and Cerebellum, not with others taking their rise from the Aorta, but with the Trunk of the Aorta itself — From this circumstance he is led to suppose that the quantity is very great $\frac{1}{4}$ or $\frac{1}{5}$ part of the whole mass. But if we correct this error, & compare the Arteries with others taking their rise from

from the Trunk, it will be found still, that
 $\frac{1}{10}$ or thereabout of the whole mass is circulated
 within the head; yet the Brain of a Man does
 not weigh more than the $\frac{1}{40}$ part of the body,
 so that four times the common proportion
 passes in here. To make that plain, from
 what you have already seen, you remember
 the age of the four principle vessels which come
 off from the arch of the Aorta & the Divisions
 which they make. Each of the Internal
Carotids is nearly as large as the Proper
Subclavian, or Artery of the arm after it
 has sent off the Vertebral; These are smaller
 than the Internal Carotids, but joined
 together they convey more blood than of
Proper Subclavian. So three times as much
 blood is circulated in the Brain & Cerebellum,
 as in one of our arms, & yet the whole arm
 weighs more than the Encephalon. Next,

689. Next, You have observed the utmost care
taken to guard against Obstructions. For the
Two Carotid Arteries are joined always in one
place, frequently in Two, by their anterior
branches; and in like manner the Carotids
are joined to the Branches w^h the Vertebral
Arteries form, these first unite and form the
Basilar Artery which supplies the Cerebellum
and Posterior part of the Brain, and then they
form their branches; and then a Circle is formed
by these arteries which has been named after
Willis. Therefore tho' three of these Branches are
obstructed by Pressure, or by humours forming,
Necrosis the Fourth, blood can be conveyed
to the most minute part of the Encephalon.
and in fact, having tied the Carotids with-
out observing that the functions of the Brain
were in the smallest degree disturbed, I
kept the animal 6 or 7 weeks, and it
saw

few stronger & faster all that time; Upon ^{690.}
killing it I found the ends of the Carotids at
a considerable distance from each other, but I
did not trace all the changes made by the
Experiment.

Notwithstanding the great quantity of blood,
and the cautious Nature takes to guard against
the Effusion of it, yet the course of it is pur-
-posely very much broke, and seems unsafe
that it should be driven with the same force
into the organs of the Nerves as into the rest
of the body; and this is brought about by a
number of Circumstances.

First, in Man the ascent of the blood from the
Common erect posture, breaks its force in
a remarkable degree, perhaps more than
Physiologists generally conceive; and many
Circumstances of real consequence to be
known, concur in this point. Thus we observe
That

691. That weakly & profligate habits are more
disposed to swellings of the feet than in y^e hands;
and this is not owing to resistance from y^e
greater height of Column of Venous blood from y^e
foot up to the Heart, for it is in no shape
material to the flux, whether the Column be
made long or short, making an allowance
for the greater friction of the sides, the blood
sinking in descending as much as it rises
in ascending. So the effect of those Columns
upon the circulating system regards y^e action
alone by increasing the height of Column
there is a greater exhalation, while at the
same time our absorbent vessels return
their fluid with greater difficulty in the
erect posture of the body —
Nearly upon the same principles it may
be observed that Wounds of the lower
extremities, or blisters, heal much more
Diff-

692.

Difficultly than in the superior parts of the body, just as an ulcer heals better when the blood moves equally, than when it is pushed on by violence, or to take other instances, I have observed in cases of Rheumatism, the pain increases by sitting in bed, and still more by putting the legs over the edge of the bed, and the pain does not instantly come on from stretching of the Ligaments & Muscular fibres, but as soon as the vessels are successfully filled. In like manner, where there is a swelling of the Testicle attended with pain, the Patient is easy when lying in bed, but on sitting up he feels a pain extending along the chord and a degree of sickness at Nausea, The Spermatic veins from their particular structure being more torpid in that posture. Or attend to the Head itself, the effects of posture upon it

699. it are very remarkable. From inaction,
Loss of blood &c, a Person grows faint, they stand
or sitting; We recover them by laying them in
a horizontal posture, when the blood passes
in sufficient quantity to the Head, which
is perhaps the chief circumstance. Or I have
remarked that when the Head is laid very
low in bed, We are more easy than ordinary,
Especially if We are laid on the back, when
the Cerebrum is thrown still lower, than
in any other posture. And then perhaps
We observe that Lydenham recommends in
certain fevers, To bathe the Patient out of bed.
The Coolness may have a considerable effect
here; but the posture concurs; and I have
seen advantage from raising the body
in different Diseases; as in Apoplectic cases.
We cannot just draw a certain Judgment,
because slight circumstances may make
an

an Alteration, but this must have a 694.
considerable effect as it must also have an Encephalo-
-spinalous case, and even in common Inflamm^{ns}.
of the Eyes. If anything further were wanting
to prove this, I would oppose a curious difference
there is between the Human Machine, and
that of a Quadruped. In the last, especially
those that feed with the Head depending, &c
Carotid, and Vertebral arteries when about
to pass thro the Foramen divide into a vast
number of minute branches, which all
run spirally, then unite into Trunks,
and these are divided a second time
before they reach the Brain; so that Nature
evidently endeavours to break the force
of the blood where the Head hangs low;
and the Vertebral arteries & the Carotids make
a number of turns, even in Man. We are
not so sure of the turns of the Vertebral ^{which}

695. which may be made serpentine to allow
of the free flexion, & rotatory motion of y^e head;
But the Carotid is not only serpentine without
the head, but in passing thro' the Os Petrosum
it makes a number of turns which seem
unnecessary and which still farther on
are again ~~repeated~~ repeated. Next, You
opened the transparency of their coats, and
particularly the thinness of the Muscular
coat within the Gammum. Next We saw
a vast number of considerable canals wh^{ch}
ran along the surface of the Brain, and
that the Pia Mater is a more extensive
(Membrane) than from looking at the
Brain we would suppose. Upon y^e whole
we would conclude that a considerable
quantity of blood is circulated at the beginning
of the Striae, and that the circulation is
performed there in a very slow & equable
manner, while obstructions are prevented
by

by the many communications between
the several Arteries.

Next, We attempt to trace the blood back to the
Heart. At the beginning of the Veins we find
nothing remarkable, their number is in
proportion to the Arteries and they correspond
with them. But after running a certain
way the leave the Arteries, & run to those
places where the Dura Mater is best fitted
to cover and defend them, or they run
into the different Sinuses of the Brain, which
are covered by a doubling of the Dura Mater
to prevent them from being compressed, or
to swell and compress the Brain. Next
the Dura mater by its thickness, and its Veins
passing obliquely thro' it, have the effect of
Valves upon the smaller branches. We are
not to consider the Sinuses as large receptacles
for the blood in which it undergoes certain
changes

697. changes; I Doubt if they be larger than Veins
corresponding to Arteries in other parts of the
body. The Hole which lets out the blood in
the Carotids, after they meet together is not
more than sufficient to carry back 4th blood,
for the Venitral veins bear a small proportion
to their arteries. Without the Head the Jugular
Vein is of a remarkable size, & its Coat is
soft yielding, because the swelling of them
is not attended with Danger. Many Veins
there is made to swell on purpose. As in
some Animals as in the Seal, there are
very large pouches found in the Jugular
Vein, and the general use of it seems
the same purpose in us.

Now comparing the structure of the sinuses
within, & of the Jugular Veins without the
head, Why has Nature contrived that the
Vein should yield easily, while within,
the

the sinues are tied down by Membranes 698.
and the small veins pass thro' these in an
oblique manner: If we attend to the appearance
of the Brain in a living animal we observe
a double motion. The first of these is owing to the
swelling of the Arteries when the Heart contracts.
It has been alledged that there was no pulsation
within the Brain, that every thing is full,
and that the arteries cannot empty themselves
without making void. But the blood goes
out of the Artery into the Vein, whereby there is
room made for a new impulse of the heart.
The other kind of motion within the Brain
perhaps is owing to the stoppage of the blood
in the Lungs which has a much greater
effect in appearance than could be
imagined; When an Animal dies the Brain
swells out to a great degree, & this swelling
is most remarkable when we are in a
State

699. State of Expiration, when the lungs are com-
-pressed, and the Nipels fall together in crook'd
lines. So there is a considerable pressure backward
and the External Jugulars have but a pair
of Valves, which do not hinder exactly the
Respiration, & therefore the discharge of the
Smaller veins into the Sinus is for some time
stop'd; Hence there is a great turgescence and
the Brain swells considerably. But this swelling
is not so great in life, as when a part of the
Skull is removed, and the parts have collapsed.
But tho the swelling out for ordinary is
mainly owing to the stoppage of the motion
of the blood, yet in other cases the blood is
thrown back by the force of the Heart and
Muscles of respiration, from the Veins of
the neck within the Head, and would not
for the oblique passage of the smaller veins
into

into the sinuses, & the great strength of the 400.
Dura mater we would be exposed to a
rupture of the Veins within the Head.

Notwithstanding of this it is not in our
power by Venesection to empty the vessels
of the Head of their blood, nor can we in life
diminish the bulk of the Brain, as y^e pressure
of the air cannot make the parts approach.

The Brain is like a shut vessel filled with
Liquors. So suppose a bottle of oil for
withing the stone, with a hole at the under
part, but it must have another hole at y^e
upper part to let in air otherwise the oil
does not run out - Now it is thus to attend
to this, as we are ready to be deceived by
examining Morbid bodies, where perhaps
there were symptoms of Obstructed Brain,
and we are ready to imagine that the
vessels

201. Vessels of the Brain are greatly stretched with blood, whereas these vessels are constantly filled with blood. I can diminish the size of my Arm by letting blood, but not the size of my Brain. I would not say therefore that letting blood can be of little use in certain Diseases, and therefore we ought in the case of Eclampsy &c. to Trepan the Patient, and let in the air in order to diminish the size of the Brain, which is an experiment that has been tried in this island in an Apoplectic case. Now, what advantage are we to get from such an Operation? Do we expose the brain to less pressure than before? Certainly not. Supposing the bulk lessened in some states of the Respiration, the pressure of the Heart continues the same, & the pressure without is increased. Nor before we make opening the

The pressure on the outer side is only equal to that on the inner, but when you make a hole in the Cranium, & the Brain subsides, the pressure of the Atmosphere having more effect the vessels are more squeezed than before, so that there is no benefit got from the operation.

Or, What happens to our Lungs in making a Perforation into the Thorax? If the mere collapsing of the organ is an argument in favour of the operation, we ought to be divided to make a hole into the Pleura in Pneumony, but the Lungs would be still more oppressed by it, and the Patient really hurt. So this operation is by no means to be thought of, putting entirely out of question the bad effect which the Atmospheric air has upon the interiors of our body. —

Lastly

709 Lastly with regard to the Brain, as the
stoppage of the blood & the regurgitation is
carefully avoided, and that as the veins
have many communications as well as the
Arteries to hinder this from happening. What
happens in Hanging? Is the Death owing
to a change in the Nerves, or to the 1st Ventricle
of the neck being crushed as Collet supposes,
or to the difficulty of the return of the blood,
or is it chiefly owing to the stoppage of our
Respiration? The last I apprehend is y^e
principal cause. The preventing y^e return
of the blood must absolutely produce y^e most
fatal symptoms; but this does not happen,
from the number of communications & anastomoses
the Vessels, & the same consequences do not
follow. Relaying of the Jugular Vein which
Lower imagined. Dr. Woddie, who wrote
on

on the Rabies canina made a hole in 704.
the Trachea of a Dog, put a rope about its mouth,
abode, and allowed it to hang for $\frac{3}{4}$ of an
hour, yet the Dog was able to walk well, but
having put the rope below the hole, in some
Minutes the Animal was quite dead —
Since that time an ingenious Gentleman
in Holland makes the same conclusion
That the Death is owing to the want of
Respiration; and He has endeavour'd to
determine the marks by which We can
know when the Death is owing to this
Cause; & the only one is, That if the rope
is put on in Life, there is a blue ring made
by it, but this does not appear if the
Body is hung up after Death —

Lect. 54^m

The Branches from the ventral Cavities
and Nerves demonstrated — Lect.

I formerly shew'd the appearance of the
Humours & Coat of the Eye in the recent subject,
and in a general way consider'd their use; But
I am now to explain the several parts of the Eye
more particularly, as being a matter of the
utmost consequence in practice.

To see clearly it is not merely sufficient that the Eye
be perfectly transparent, and the bottom of it
equally sensible; but there is further a collection
made of the light reflected from the object, so
as to form a picture of it at the Bottom; The rays
are thrown together to give a stronger impulse;
just as it done by a burning glass in collecting
the rays of the Sun. And in such an Experiment
there is not only a greater brightness & Heat, but
a stroke is given to any light substance on which
the condensed rays fall. Our Eye is equally
fitted in all these different respects necessary
for

for Vision, for whilst the Nerve is expanded in a very curious manner, the Humours of the Eye make a defence to it, keeping it soft & moist, They allow by their pellucidity the light to enter, whilst by their shape they collect it.

This collection of the Rays is performed by the Crystalline Lens, partly from its Density and partly from the Shape, just as if we take any common glass, the figure of any Object is represented beyond it in the most exact manner. But in a living Animal the collection is still more accurately made, than by any artificial Lens, owing to this, that when we have shaped a glass accurately, every part being of equal Density, the Rays of light entering near the edges are collected sooner than those which enter in the middle. But the Lens is softer on the surface, than in the Centre, by which the power of forming the picture is diminished at

707. at the edges, and shew an accurate representation of the Object given. In account of the softness of the lens at the surface, & to preserve the figure, we find that the Body of the lens is enclosed in a capsule which is a firm, and thick substance. A want of attention to the use of the softer structure of the edges, has given rise to a mistake, that the lens swims in liquor, the outer part becoming soft after Death. In Young Subjects, Vessels which can be injected with a colored liquor, and which contain red blood are dispersed in the posterior part of it; and this, as I mentioned before, is a proof of Sympathetic vessels communicating in red Vessels - We also perceive that the body of the lens may be readily detached, & the Capsule left behind - and this proving the same firm structure with the rest of the Animal may be susceptible of similar Diseases, and

and particularly of Inflammation, and I 708.
Therefore in performing operations if we leave
the Capsule there is danger of an Opacity
forming — Next, the whole posterior part of
the eye is filled up by a substance resembling
the White of an Egg, which we call, Vitreous
Humour, the surface of which remains smooth
after the Coats are taken off, and from this
circumstance of the Vesels being regularly
dispersed we must suppose it also covered
with a Capsule, & this is subdivided by
cross partitions, tho' these are so minute
that we cannot by Dissection give a clear
Demonstration of them. We were also left
to determine from what Vesels the Vitreous
humour was secreted, at first sight we
would imagine that the Vesels of the
Choroid coat, or of the Retina were best
fitted for this purpose, but as the Crystalline
lens

709. Lens receives those vessels which furnish all
the Viscous humour, it would seem to be
nourished in the same manner, especially
as the Choroid Coat is covered with a Vain, wh
is so thick as to represent a Membrane, and
in which we cannot demonstrate vessels.
The Viscous humour serves two very evident
purposes—^{1st} It gives a soft Degree to
the Retina, nothing can be better fitted for
guarding that substance from injury; But
its chief purpose is to support the Lens at a
proper Distance from the bottom of the Eye,
while it also assists the lens in forming the
picture; It has a certain Degree of tenacity for
this purpose, but were it thinner its effect in
this respect would be still greater.

Now, I turn attend to the situation, & Use
of the Aqueous Humour, which is placed
between the Crystalline lens and the Cornea;
1007

710.
Think There is room to imagine That the
Pellucidly of the Cornea is in a great degree
owing to that Watery substance continually
passing thro' its pores; For on Dissection of Cornea
we find a Watery matter interspersed between
the several Lamellae; Long soon after Death, there
is a change made on the shape of the Eye: So
there seems to be a very ready passage thro'
pores at this place, and the Aqueous humour
is supplied in very great quantity. So if it is
let out by a wound in the Cornea, when
the Wound closes again, the Cavity fills in
less than a Decys time. Further, without the
Interposition of the Aqueous humour, the
Crystalline lens, & the Iris the anterior
parts in the Eye would have been exposed
to Danger from the slightest Rib on its fore
part, but the Aqueous humour prevents it.
Now, If we suppose the Crystalline lens moves
back-

III. Backward & Forward to accommodate the Eye
to objects, the Aqueous humour admits of this.
But the chief use of it is, To give room to the
moveable curtain the Iris to play readily
within it.

Next, turn your attention to the Coats of the
Eye, and I shall begin with the innermost,
having the Cornea for its source.

You remember that the optic nerves begin
from certain tubules called their Thalami
which are placed at the bottom of the lateral
Ventricles, & at the side of the 3^d Ventricle.
Now from this situation you explain a
fact which frequently occurs in Practice,
That Water collected within the Head, very
readily affects the Eyes. All the Ventricles
communicate, making them like one
common Ventricle, so a pressure is made
not only on the top of the Thalami, but on
the

412.

The inner sides of them. So the bottom of the
Eye becomes less sensible of Light in the
Hydro-cephalus, and the Pupil is of course
considerably dilated. When afterwards the
Water is collected in greater quantity, Nerves
more remote come to be affected sometimes with
Paralysis, sometimes they are so irritated as
to produce Convulsions. Next, following
the Optic Nerve from the Thalami downwards
We find that they join together They are not
tied loosely together with Cells as Haller
supposes, but we find that the Medullary
parts of the Optic nerves are as their meeting
Indurated i.e. The Optic of the Right Eye
is formed from both sides of the head, there is
a real Occupation of Medullary so at this
place, and I think the Purpose of it is quite
evident. We derive many Advantages
from the use of two Eyes, as the Judging of

719. of the situation & distance of objects; besides
accidents are guarded against, and I shall further
by the Intermixture of the Nerves of the retinae;
suppose the origin of one totally destroyed, We
still retain half the sensation of both eyes.
and are able to judge of their distance, for tho'
We should lose one eye, we are still able to
perform the necessary functions of Life. After
these Nerves get into the Orbit, they are im-
mediately covered with the Dura Mater, to
serve as a Defence in the motion of the Eye,
which is the only purpose this membrane serves
here, or to the Nerves in general; so on pursuing
this Nerve into the Eye, this external coat is again
laid aside, & the pure Medullary matter enters
to form the Retina. The Optic Nerve does not enter
the Eye directly opposite to the Pupil, but at its
inner side nearer to the Nose. Hence of this is
evident from a fact discovered by Mariotte

in the last Lecture, That a certain part of the^{114.}
Bottom of the Eye is insensible to the picture of
objects made upon it. To shuttling the Eye and
bring a picture upon the Optic nerve by turning
the Eye to the opposite side, when we have
brought it a certain length we lose the object
entirely. We might suppose that this is owing
to the Obliquity of the Eye; but upon turning the
Eye a little further, we see it again, and therefore
to do so notwithstanding that the Eye is turned
with a very great degree of Obliquity. Hence We
see the genl. purpose that the Optic Nerves are
so situated that the picture of no object can fall
on both at the same time; so we never can
with Two Eyes lose an object, or We are never
sensible of this defect by having two Eyes.
The only Difficulty here is to determine, Why
that portion of the Optic nerve is insensible?
& this Difficulty is so great that Marriott
thought

715. Thought that not the Retina but the
Choroid Coat was the true seat of Vision; Or
not to follow this Idea it may be supposed that
Blindness is owing to the Central vertices. But
the movable part of the Eye is greater than is
sufficient to cover the vertices. I suppose an object
equal in Diameter to $\frac{1}{10}$ of my Distance, that is,
If my Distance is 9 feet, I suppose a foot in Diameter,
and measuring the optic nerve, the invisible
spot answers to the whole of its Head, when
we attend to the angle the Eye forms with the
object, I know that the entrance of the optic
Nerve is nearly $\frac{1}{6}$ of an inch removed from the
axis of the Eye. That Mariottes Idea of the
Choroid Coat being the seat of Vision is uncommon
appears from a variety of Circumstances—
Were this the case the Retina would be
almost useless; Nor has we attended to the
Thickness of the Coat, the Reflex upon it, and
the

The point on the inner side of its ^{716.} Nerve
in Hydrocephalus what acts on the origin of
the Optic nerve affects the Sight &c. So the
matter turns on this, That till the Nerve is
divided into fine & delicate Sparks it does not
convey the Idea of Objects. Just as when we
collect a picture on the Membrane of the Nose,
or Tongue we do not see it.

We must follow the Nerve on the inner side
of the Eye, where it gets the name of Retina;
tho' we find no Net work form'd here, but the
expansion of the Nerve is Uniform, and it
terminates at some distance from the ^{4th} Crisp-
Lent, or where an object ceases to be represented
on the bottom of the Eye; tho' light should
fall never so obliquely, it cannot strike the
Back part of the Choroid Coat. So we are not
under Necessity to Enquire the Retina as
continued to cover the Crystalline Lent,
some

217. Some few threads of many perhaps be continued
so far, but it communicates as a Membrane at a
considerable distance from it. Upon the Retina
a number of Vessels are dispersed, and we would
Judge that these are very numerous from
seeing the size of the artery which enters the
Optic nerve, while no other arteries perforate
the Choroid Coat; and we would say that
these Vessels in a sound Animal enable
the Stave to communicate its inspirings
with greater accuracy, but the real effect of
the Artery upon the Stave is not well understood.
We only observe that a large Distribution
of Arteries along with the Sensitive Nerves
is necessary, to fit them for their purpose.
Now, You will observe further that these
Vessels in their whole course may in
Disorders affect the Staves; so the Structure
of the Ocular Artery may affect the Muscles
of

of the optic nerve. So when a Person who has
 drunk much strong liquors, sees as it were,
 flashes coming from the Eye; this is owing
 to the stroke of the Atery; and in other cases
 where Blindness & Inconspicuity takes place
 it may be very much owing to the diseased
 state of the Atery, even without the supposition
 that the blood is extravasated, or that it discolours
 the Distinguished by the Deposition of y^e body.
 The next Coat, the Choroid, has a faint red tinge
 on the inner side of it, and the outer side
 very vascular, and the vessels are numerous,
 perhaps to produce this faint. The use of
 this faint is nearly the opposite to that of
 Quicksilver on a Mirror; it is intended in
 the Human body, and in these Animals
 to absorb their prey in the Daytime, to
 suffocate the rays, so it is of a very dark Colour.
 But if the impression is very feeble, as in these

719. Those animals which seek their prey in the
Night, a colour is added, & the reflection from it
gives a stronger impulse to the Retina.
Following the Choroid Coat further, it is turned
inward, & is joined to the Hyaloid line, where-
by it supports the lens, & divides the aqueous
liquor from the vitreous. The nature of the
Ciliary processes I endeavour'd formerly to
explain to you, that as a larger circle is turn'd
into a smaller one, the Choroid coat has many
doublings, as in the sleeve of a shirt when it
is vacuum is to be found to the wrist, so we
are not to conceive spaces thro' which the
Light may pass left between the processes,
which might lead us to mistake wth regard
to the degree of sensibility at the bottom of
the eye. So if a Person is to have an operation
done for the Cataract, Surgeons just suppose
that it is not to be undoubted unless the

The Retina populus is full of sensibility,
 But suppose a Milky or very opaque, very
 little light may get to the bottom of the Eye
 and yet it may be sensible. Dr Porterfield
 has supposed That these Processes avoid the
 purpose of a Crystalline lens, but I doubt
 much of that, the Processes are of the same
 thickness with the rest of the Membrane, and
 there is no room to imagine that the whole
 Contracts, nor can it separate itself from the
 other coat, supposing the lens capable of
 being made flatter, the Choroid Coat would
 rather have a tendency to do this, by pulling
 its side, but it is not calculated to perform
 a such motion, and when the lens is contracted
 I am persuaded That Corpus populus nearly
 the same power of altering the Eye that we
 do, so the alteration does not depend on
 that circumstance. Next, We observe
 that

721. That where the Choroid Coat begins to form
the Lachrym. process, the Iris is connected to it
by a Dense Cellul. f., in so much that before Linn
wrote, the Iris was supposed by Anatomists to
be the continuation of the Choroid; But Linn has
shown it to be a distinct substance. You all
know that it performs a very free motion, as it
contracts & dilates readily. Now an Anatomist
finds himself at a loss to demonstrate the
Mechanism by which those motions are done.
There is in it a number of longitudinal lines
that are somewhat serpentine, but these are
little calculated for the contraction. We see too
one part that runs zigzag in a circle, which
is a fibrous substance, not blood vessels; and these
lines in the right direction are continued
to the very edge of the Pupil. The fibres are
supplied with a number of blood vessels &
Nerves, much beyond the common fibres, and
we

It is a curious circumstance, that they^{722.}
are all united near the root of the Iris, and a
circular artery formed there, from which branches
are sent off every where. It is evident therefore
that the Arteries of the Iris do not according
to Haller &c. convey pellucid liquors only, but
that red blood is circulated in its many
great quantities, only the redness is concealed
by the coloring part of the Iris. Somewhere
this was evident, on extracting the lens I observed
that immediately the red blood ran out from
it. May in such cases an Inflammⁿ is often
produced, and a red speckled coat from the
Iris, thro' the wound of the Cornea. So the
circulation is carried on there in the most
common manner, and probably y^e Aqueous
Humour is secreted from these vessels, for
when a Subject is laid on the back, and a
fine

723. In injection in Morbum, the Colours at first
Does not get into the aqueous Humour, but
after sometime the little streaks of oil rise
thru it from the Iris. Let us next consider
the use of the Iris, and the manner in which
We regulate the motions of it - You all know
That it is contracted when a strong light enters
the Eye, so it is intended to exclude ~~it~~ ^{light}
gradually, to hinder it from blinding the bottom
of the Eye, or from rendering the Retina ~~con-~~
-fused. Now further, the Dilatation is a motion
performed by the power of instinct, as much
as the Contraction is, and on some occasions
We observe it in a remarkable degree, on
account of the use where the Dilatation is
found to serve. So I have seen in two or
three cases of Hydrocephalus, That when a
Patient was teased by bringing a strong
light

light shines upon the Eye instead of 724.
producing its Contract, I observed a great degree
of Dilatation. Dr. Whyte gives a case of this
kind, but he is mistaken with regard to the
Cause of it. This is not primarily sent. irritation
bringing on a convulsive motion, for the
motion is regular, but in this situation of
the Eye being more insensible than common,
requires a greater quantity of light, and the
Patient at the instant is making the effort of
seeing, and being rendered by bringing the
light, and being taught that the contraction
would have the contrary effect, the Dilatation
the Pupil. And we are not to consider
that the Iris acts like a spring in the
Dilatation, for as the Circular fibres contract
it regularly, the Longitudinal must act in
the same regular manner. The power
of these fibres is very remarkable in some
Animals

725. Animals, as in Birds, Thus a Parrot moves
the Iris with the same ease as we do our
fingers. The Pupil is no a point, then Dilates
it considerably, as you may observe by
opening the Animal in the Twilight,
any thing that pleases it. Further, the
~~Scientific~~ Scientific seems attend to what happens
when we observe very minute objects, We
accommodate the Pupil to the effect these have
upon us, and not to the quantity of light.
Thus if I accommodate my eye to the point
of a Pin at 9 or 10 inches distance from me,
and then bring it nearer, the Pupil is
contracted tho' the quantity of light is y^e same.
Just as when I bring a small book near
the Eye, and interpose a bit of paper with
a hole in it, I cut off the superfluous rays
and an accurate picture is made at
the

the bottom of the Eye. From knowing the ⁷²⁶
use of the Iris, we judge of the state of its bottom
of the Eye by looking to it, for its contraction
does not depend on the light affecting the
Iris, but proceeds from the effect of the light on
the bottom of the Eye, so as the optic nerve
is more or less sensible, the Pupil is more
or less contracted.

We next add the outer coats, The Cornea and
the Sclerotics, which are portions of different
Spheres or Circles, our Cornea being more
convex than the Sclerotics. The Cornea collects
the Aqueous humours, and being strong serves
for the defence of the Interior organs, But it
also collects the rays remarkably. If the Eye
had been covered with a flat membrane, the
Iris must have had an immoderate play
in order to accommodate the eye to the quantity
of

704. of light. Whereas the light by entering thro' it, falls upon a small part of the eye, so that by a small motion of the Iris, the Eye is adapted to the proper quantity.

The Sclerotic Coat serves as a Defence; In the diseas'd state of the Eye we perceive vessels on the Cornea, which are first found shooting from the Sclerotic Coat, and cover the eye from the one side to the other. The Ball of the Eye is surrounded by the Punica Membrana or Conjunctiva, which makes the inner side of the Eye lid, whereby Dust, and other substances are prevented from getting into the Eye, and the whole is wash'd by the Tears.

It only remains now, to give you some notion of the power by which the Tears pass down from the Lachrymal Gland into the Nostril, of which I believe no very tolerable acct

account is given. The Lacrymal gland ⁷²⁸
You know, is situated at the outer side of the
Eye, that the tears may pass along the whole
fore part & wash it before they reach the Puncta.
Now which they fall at length by their weight,
but we assist the motion by the action of the
Circular muscle, which draws the Eye side
from the outer side, to the Inner. They are
next pushed into the Puncta, by those Passes
where Capillary tubes, & pupils of attracting
Liquors. Now after the Puncta are filled, if no
more tears are supplied the motion ceases, the
attraction of the rings at the Puncta prevents
them from dropping into the Nose, & they remain
suspended, just as a Capillary tube keeps
Water suspended in it. But if more Tears
are added, then the Ducts begin to run, and
continue to do so as long as this supply is
made.

129. You know the effect of a Siphon, or crooked
tube with two legs of an ^{une-}equal length. If
You fill this tube (I suppose it a large one
and without the power inherent in capillaries)
with any liquor, turn it the other way; as
the weight of the air which is an Elastic body
is the same upon both ends, it is evident
that the liquor would run out from the
end where the greatest weight is, downwards;
I therefore I am next to dip the short end
into a Vessel of Water, I can in this way
empty the Vessel entirely. But I find that
tho' I keep my ~~head~~ head undermost, the
tears still run into the Nose, so, by power
of capillary tubes we must add a Centrum
which shall be the Punctum, and also
some degree of Muscular motion; and I am
told that Albinus on touching of Punctum
Loeb-

Sadismale was a good sporter, but I have
 not been able to see the contraction; and tho' I have
 not been able to observe that, yet I have seen
 but these ducts possess some degree of Muscular
 power. Why next do the Ducts terminate in
 the Nose? We are told that they end there
 in order to wash it; but the Nose is sufficiently
 supplied with Moisture, for what the Air
 carries off in Inspiration, is added again on
 Expiration, nor does the Sadismale Duct open
 above the Os Spongiosum, where the Bone is
 placed in the current of air, but below it.
 So they enter there because that part is defended
 from their access by the Mucus separated
 from the Membrane of the Nose; and I have
 a suspicion that there is a farther conveyance
 of Mucus by the Ductus incisivi, as in several
 subjects there is a communication from
 the

791. The Nose to the Mouth in this place, and
the end of the Esophagus is turn'd towards
it. At the same time I have not been able to
trace these ducts in many subjects into the
Mouth, and on pouring Coloured Fluids up
into My nose, I never was sensible of a Colour
or taste in my mouth; but from their situation
I have a suspicion that some thing of that
kind takes place.

Lect. 56^m

The Est-Carotid Arteries, & the corresponding
Veins demonstrated.

Lect. 57^m

The Stomach which correspond with the Est-
Carotid Arteries demonstrated.

Lect. 58^m

We shall now review what we have
last demonstrated, beginning wth the Stomach.
The

The 1st Pair, The Olfactory, taking their origin from the Corpora Striata of the Brain, run forwards under a furrow of the Anterior lobes of the Brain; or the see the Nerve defended from the pressure of the Brain by an arch form, while in y^e mean time in its course it receives the addition of branches.

When it gets forwards to the Sphenoid Bone it divides suddenly into a number of parts, to enter the Nose, Nature making the Divisions as soon as possible to lessen the number of insensible spaces within the Nose; and as it is immediately conducted to its turn on by the Membrane of the Nose, and not exposed to External adverse organs it does not become a sheath from the Dura Mater, which as I observed before serves only for the safety of the Nerves, & is not instrumental or necessary in their office.

The 2^d Pair, The Ophthalmic Nerves are joined together

739. together in the manner I explain'd. From
this connection many eminent Physiologists
think We may explain the Uniform
motion of our Eyes; Not reflecting that the Optic
Nerves are not connected with the moving
organs. What I think suppose that We may
explain, Now from two images form'd upon the
Eye, we receive as it were but one impression;
but this circumstance at little depends upon the
Union, as is evident from a simple experiment;
If I direct both my eyes to the point of my
finger I see it as one; but if I place my finger
before me, and direct the Eye to a distant
object the finger appears; Whereas if it depend
on the connection of the Nerves it w'd remain
single; and I shall afterwards shew the
meaning of what may call a Duplication, as
in fact two pictures come to be form'd. Tracing
the Optic Nerves, They lay aside their Coat
with

which is added to the coats of the Eye, as 734.
being merely a defence. Where the Scur forms
the Retina there is beyond all doubt a division
into most minute parts, as appears from Fig 4.
The smallness of the pictures which make impressions
upon our Eyes. So I can easily perceive the
smallest Threads of a Cobweb at the Distance
of 30 Feet. Now measuring the Diameter of
the object, & considering that it is diminished accordg
to the Distance, in proportion as y^e Distance
from the object to the middle of the Eye is greater
than from the middle of the Eye to its bottom,
We will immediately perceive that y^e picture
must be extremely minute. But further I shall
have occasion to show, That when we look at
any object, as a Dart, the rays of light Fig 5
within our Eyes, they decussate about the
Crystalline lens, so that the picture is inverted
upon the Eye. Hence we cannot only distinguish
objects

795. Object, the Dimensions of the picture of which
Does not exceed the 24.000 part of an Inch, but
We distinguish in the picture various parts
One part of the Object differing from another, it
is probable therefore That we have not yet fully
reached the Division of the Nerve, and that the
picture Does not affect a single fibre of a Nerve
but a number of them. This gives a clear and
certain proof of the minuteness of our Nerves, and
shows the impossibility of tracing them to their
end by Dissection; Or that many organs may
have nerves, which it is not in our power to
demonstrate. The next use I would make
of the Observation of the vast Division of the
Pituita Gland softness is, That from viewing
this organ there is no reason to connect the
Innervation of Nerves & Muscular organs, there
is no possibility of the Pituita contracting in
any shape; so besides Division there must
be

be some very singular modifications, providing
 That Muscles are the moving extremities of 4^e
 Nerves as some have apprehended

The 3^d Pair have been call'd very properly
 Oculi Motor for it supplies Three Muscles of 4^e
 Eye, & Eye Lid besides the Iris, so it terminates
 almost entirely capable of motion. Now let
 us recollect the corresponding & Uniform
 motions which take place in our Eye, or the
 Sympathy as Authors speak. I have observ'd
 That the Iris is brought to move, not from the
 Light acting immediately upon it, as Haller
 thought, but because the Light impresses
 the Retina or Optic Nerve; yet we cannot
 pretend to show a connection between the
 Optic nerve & the 3^d Pair; so one nerve seems
 an Impression, & another communicates
 motion without any immediate connection
 between them. Next, We observe that it moves
 merely

737. merely tied together in one sheath, or having
the same root, do not perform uniform & regular
motions at the same time; for this very scarce
series Muscles which are Antagonists, as the
Abollens & Depressors, which tho' may act
at the same time, & draw the whole ball into
the Orbit, are yett thrown into action separately,
so that we can at pleasure turn the Eye up
and Down. Next, That several & numerous
branches to the Iris, or, as Nature is very solicitous
in sending to that organ a vast quantity of
blood, and of preventing all danger of stoppage
by the Circular Artery at the root of it, in like
manner an unusual number of Nerves
are distributed to it, & these in their course
to the Iris, form a Ganglion, or Knot. And
you will observe That these Ganglia are to
be found where organs are very necessary to
Life.

The

The 4th Pair, have a constant & very remarkable course. It begins at the back of the Brain, from the Cerebellum chiefly, runs round the Cerebrum, and after all it terminates upon the Single Muscle, The Trochlearis. In the same manner the sixth pair ends, all but a few Branches which connect it to the Intercostal, upon the Abductor. We must suppose some material purpose served by this singular course, and this supplying but one Muscle, and yet I cannot in any manner explain it. For as to the motion that the Superior Oblique being expressive of the Respiration, and therefore needing a separate nerve, the Superior Oblique operates with it, & is equally an Antagonist of the Rectus Muscles.

The 5th Pair, is by much the largest of any of the Head. We see it spread out broad, but without forming a Ganglion, or We may

799. may compare the Thumb to the Wrist, and
our fingers to the six branches. The first
branch enters the Orbit, & supplies several
parts within it, one branch in particular enters
the Lacrymal gland; another remarkable
branch enters the Nose, which is not perhaps
yet prosecuted to its termination. Then we
find a very considerable Nerve running to
the Corner of the Eye, and still larger branches
supplying the Frontal Muscles & teguments
of the Cranium, while further back on the
Cranium we see branches of the following
Nerves, and also branches of the Trigeminal.
Wounds therefore of the Cranium are not
only attended with pain, but with the highest
degree of Danger. So I have met with one
Case, where a slight wound of the Head
produced an enormous swelling of it, and where

746.

where by enlarging the Incision, and
dividing the Branches of the Artery the cure
was in a great measure performed, and I
have met with other two Cases where a slight wound
of the Cranium proved fatal, probably owing
to the Laceration of one of these Arteries. I both
pairs to point out their particular situation,
and if we are to make exact ones, & possibilities
of the parts of the head, as Waller and others
have attempted to do, we must be carefull
not to begin with cutting transversely near y^e
bottom of the Ligament, but begin above, &
lay in vivo the part on which you make
the Experiment, leaving entire the Trunk
of the Artery & Branches sent off from it, for
if the Trunk of a Artery is cut, all Organs
will appear insensible.

The second branch of the 5th Pair is named the

741. The Superior Maxillary nerve, the whole
almost terminating in the parts of the Upper
Jaw, the Teeth are supplied from it, & ^{is} ^{the} remaining
branches from the Infra Orbital nerve, some small
branches run backward, one of ^{is} ^{the} greatest import-
= ance making the beginning of the Submaxillary,
what remains runs down the Palato Maxillary
of the roof of the mouth to the nose, to which
it sends a branch as large as the Olfactory, which
enters toward the Posterior part.

The Third Branch, the Inferior Maxillary, after
scattering branches to the side of the Head and
cheek, and supplying the Elevators of the Lower
Jaw, runs downwards, enters the Maxillary
canal, and comes out again upon ^{the} Chin,
while a large branch supplies the Salivary
Glands, and ends on the Tongue. So we
may

may consider the 5th Pair as serving to 742.
Distinguish Taste accurately, While the 8 and 9th
Pairs assist entering the substance of the Tongue.

When we now recollect the origin of the first
Five Pairs. That the Three first come from the
Brain, and the two last from the Cerebellum,
or at least almost entirely so, We find that they
all serve the same office, That they serve as
Organs of Taste & sense, They perform secretions
as well as Voluntary motions. So there is no
Reason to imagine That the Brain & Cerebellum
perform different offices; And those Authors
who suppose they do, have not the ground
Work of Anatomy to support their opinion.
On comparing the Olfactory & Otic Nerves
with the 3^d Pair, we seem to perceive a
Difference of Texture. The Otic Nerve being
of

749. of a Whiter colour than the Third pair, so we
might conjecture that Sense & Motion by a diff^t
energy or Medium, by their structure essentially
differing. But we find again that the 5th
Pair excites Sense & Motion, & enables us to stand
to perform Section, &c. on comparing of real
Branches in the most careful manner, I do
not find any apparent Difference in their
structure. So by this we are led back from the
other Conclusion, and we see that one Medium
or Structure serves for all these two purposes.
And we can explain the Difference in the
appearance of these Nerves where a motion
is performed, Coats of greater thickness are added,
& we alter the colour & structure; and in
the case of the Olfactory & Optic nerves, there
is no danger of being hurt, hence the Medullary
substance passes from the Brain.

But in the case of those Nerves which are
 far extended and are in danger of being inter-
 rupted in their course, Nature bestows on the
 Nerve a power which Authors have not alluded
 to. That very Nerve in its most distant extremity
 resembles the structure of the Brain, an energy
 is communicated thro' the whole of its course,
 or the Perimeter performs the same office to
 the Nerve that it does to the Brain, They all
 having a logical seed in their course.

We mentioned the 6th Pair as ending in the
 Abductor Muscle, so the only remark with
 regard to its connection with the Intercostal
 Anatomists have disputed whether it
 comes from or goes to the Intercostal. Now Jap-
 -schend there can be little doubt. If we ask
 Whence the Intercostal receives its Nerve?
 You would imagine that it was itself a

745. a large source of Nervous energy, but it is
merely a connection of one Nerve wth another
in its progress; and on examining the 6th Pair
I think I can shew that it is larger before this
joining with the Intercostal Nerve afterwards,
and therefore the Branches are descending from
the 6th to join with the Nerve which forms
its very first beginning. Why this should be
sent thro^{gh} the same Canal with the Internal
Carotid is not easily determined, but I would
make one gen^l. remark, That Nature exposes
the Nerves throughout the whole of y^e body
to the action of air, & partly to the Arteries,
so that both Systems may be included in
one gen^l. Description, and this is probably
an action & reaction of parts upon each other,
the Arteries contributing a somewhat to y^e
Nerve, and this communicating in its turn
an

an energy to the activity.

The next nerve the 9th Pair, splits into two parts. One of these runs thro the Bone, & getting outwards is covered by the Dura Mater, and is called Portio Dura. Within the bone it joins with the 2^d branch of the 5th Pair, & then again after it gets a certain way further it is joined to the 3^d branch of the 5th Pair by the Chorda Tympani, which comes chiefly from the Portio Dura, Nature thus sending Nerves to the Sense of Taste, and for actuating the Glands of the Mouth from the diff^t places. After the Portio Dura gets out from the Bone, it spreads wide out from the side of the Face, and the Nerves are very numerous here, as the Muscles of the Face not only open & shut the mouth, but they serve to express the Passions. And, The Branches of the Portio Dura are every where

747. where connected to the branches of the Fifth
Pair, & to the Cerebral nerves in a way wh^{ch}
resembles the Anastomosing of the blood vessels;
but tracing the Nerves thro' out the joining
is quite different. We do not find two Nerves
joining to form one fibre or canal. The two
cross each other, and only are tied in a same
bundle, then afterwards make a division.
So suppose two Muscles to be supplied, instead
of the one receiving a Nerve from the Portio
Dura, & the other a Nerve from the 5th Pair.
They each receive the half of the Nervous fibres
from the one source, & the other half from the
other. By this accident is guarded against
for it is surely better that we should possess
half the power or strength of the Muscles wh^{ch}
open & shut the Mouth, than that we sh^d
possess the full power of the Muscles wh^{ch}
open

open, without any power in those which
 shut it. And the same thing will be found
 to be very frequently done in the body. The purpose
 however has been overlooked by Authors who
 conceived that this joining was to make the
 co-operation of parts, whereas freq^t these muscles
 are analogues to each other —

The next time the 8th Pair, seems and looks in
 or accessory nerve, but which is not to be
 considered as actually making a part of it.
 It only passes thro' the same hole in the
 Skelton, for in the recent subject there is a
 different hole in the Dura mater, and the
 Accessory nerve runs distinct from the 8th pair
 to a certain muscle of the Shoulder, and is in
 every respect a Muscle of the Neck. The proper
 8th Pair is divided by Haller very properly
 into two parts. 1st The Nerves of the Pharynx
 or a branch that supplies the Tongue and

Thy. and Pharynx and serves a number of times
of the utmost consequence to the Crochid Artery
and which runs perhaps as far as the Heart;
Not that we can show them communicating here,
for spreading out into a Web they seem to make
part of the Membranous Coat, and the Threads
are so minute that we cannot with certainty
pursue them. The other part furnishes the
Spiryval muscles, and here we find Nature
solicitous to procure this part as the Voice
and the many advantages we derive from
it depend on the small muscles situated
here, may, as Life itself in a great measure
depends on our Digestion, and tho' when
other muscles act with Vigour, a solid
mass pass without much danger of getting
into the Larynx, in swallowing fluids the

The concurrence of the muscles of *larynx*
is altogether necessary. Hence the Stems
come from two diff^t sources, and I long ago
doubted of the experiment which has been
mentioned by some accurate Anatomists,
That on cutting the Recurrent nerves, & voice
is lost; and on making the experiment
I found this to be the case. After cutting
these stems I kept an animal for six
weeks & upwards, and I found that the
voice was almost & weakened, but the
animal still possessed considerable powers.
The last of the Neck, the 9th sends branches
to the cut-muscles, then with the 5th branches
into the 20 of the tongue, so that this organ
receives Nerves in an unusual number
as will appear when we come to consider
the

934. The Sense of Taste.

We must trace the Branches of blood vessels,
only we would attempt just to determine
a genl. question. You have now seen
enough of the Distribution of our Arteries, &
the manner of Circulation to be able to
determine how far in Diseases Antisiphon
may be serviceable, or preferable to Suction
and Steel, Whether in Local Diseases we
would let blood from a neighbouring Artery
& Vein, or from a distant one —
Looking into Authors We find a vast deal
said about Deviation and Revulsion, by which
is meant the Deviation or diverting of the
blood current from a distant part — Now let
us see how this is to be done — I avoid
at present altogether saying any thing
of the proper way of opening the Artery or
Vein

vein, and avoid entering on the particular
 degrees of danger that attend either operation,
 or the cause of the danger, it is enough that we
 take a fact, that the blood is thrown wth more
 violence from the Arteries, or loses its force
 in the Veins. Next, we shall put out
 of question the consideration of Diseases where
 the whole habit is affected where it has been
 supposed that letting blood from the Artery
 has more effect than from a Vein, as in an
 Inflaming fever, tho' where a small artery is
 opened, or a small hole made in a large Artery,
 I wd rather alledge that the good done is owing
 to the quantity let, and the time in which ye
 operation is performed. And I would suppose
 that we can only with advantage consider
 that question with respect to a local Disease.
 Thus

159. Thus suppose the Brain or Head any where
affected whether an artery or a
vein? And whether a Distant, or an adjacent
vessel? Perhaps if the nearness is determined
it will serve to determine both, and the more
to shew with an Absolute certainty, and yet
Authors run more into the contrary opinion.
For opening any vessel where there is an Efflux
in the part, the blood running out there is a
less push upon the undischarged part, or course
is diverted to the part opened, so they suppose
the further they turn it from the diseased
part the better; Or that by opening a vessel
of the foot, they relieve more, than by one in
the Head or Neck. Wallerius conceived
too which seems to prove this; He opens a
branch of an artery or vein, and he finds
that

754.
That the blood not only runs with more
rapidity in the opened vessel, but also in
the corresponding neighbouring ones. But this
does not show that the opening a distant vessel
is better than a near one, for the increase of
velocity does not imply an increase of force,
the force not being in proportion to y^2 quantity
and velocity, but we must attend to y^2 resistance.
So, look to the Heart, the quantity of blood pass^g
thru the Pulmonary Artery and its velocity
are the same as in the Aorta, and y^2 force is
very different, this being in proportion to the
thickness of the vessels, the resistance being
greater in the Aorta. Were the resistance the
same, when the Left Ventricle contracted, y^2
velocity in the Pulmonary artery would
be much less. I shall mention a plain
argument from the injection of dead bodies, suppose

755. Suppose the pipe fixed in the Aorta, any one
Artery bursting, & find those next to it are
not so well injected as those which are at a
great distance. So if one about the bottom of
the belly bursts, those in the Legs are not so
well injected as those further up. Or suppose
a Water pipe sent off in pairs of branches, at
a mile distance; if one is cut, the one wh^{ch} is
opposite to it will receive less Water in less
than one at a greater distance. So y^e means
the Disease past the opening is made, the
greater will be the relief. Granting this, it
only remains to determine whether it be com-
munications by means of Veins & Arteries
with the Disease past are more immediate.
Thus suppose a person labouring under an
Inflamⁿ on the side of the head, I may do
service by compressing the Arteries in their
course

756.
course, preventing the blood from being
drawn in. But suppose the Inflammation
under the skin, & over the Aponeurosis of the
Temporal muscle, the opening the Trunk
of the Temp Artery itself will give most
Relief. But next, suppose that this Trunk
had passed deeper, or been so that the Surgeon
could not reach it with his instrument, I wd
next consider whether whether I am to let
blood from the Cephalic Artery, or from the
Temporal vein, whether from the vein
corresponding to the Descend Artery, or from
an Artery in the neighbourhood. And the
Conclusion will depend on ^{the} Anastomoses
with the adjacent vessels, if these are large
I would prefer the Artery, but if small I
would open the corresponding vein. Next
I wd open a vein in the neighbourhood, rather

754. Rather than at a distance. So if a Persons
head is oppressed, and Arteriotomy out of the
Question, the opening the Jugular vein would
do more service than a vein in the arm, and
from that in the arm, in consequence of the
joining of the Brachial veins with those
about the neck, would be of more service
than from one in the foot.

Now we shall trace the Arteries & Veins in
their order. The Trunk of the Caroties communes
Running somewhat without branches,
is proper for determining the age of Arteries
or for making experiments, the cutting and
portions of it &c. and I would agree with
Dr. Cramm, that in certain Diseases, procured
from too great a flow of blood into the Brain
there may be advantage from that Artery,
or the Internal Carotid Branch of it. But in
Man

Man we are not to make the first experiment,
 I would first try it in other animals, because
 it depends of the Danger in tying the Artery,
 there is great Danger from the situation of the
 neighbouring Stems. I know that a slit
 made in the Skin, & the drawing back of
 the part so as to expose the Intercostal Artery
 and 8th pair, to the air, for a few minutes is
 of the utmost Danger, and that animals will
 die in 20, or 30 hours after this is done, i.e. by
 the time the inflamⁿ comes to seize upon the
 Stems. Following the Theory of the French
Communists it sends off the Int^l Artery & makes
 the Angle, and the Artery is more in the
 Line of the Throat. So we are not to adopt
 the Theory of Bowdich, that the Punctures
 and other parts of the blood run straight
 to

769. To the origin of the veins. From the root of
the Est-branch, the Cavernosal Artery is sent
off, which supplies the Thyroid gland. Thence
a large artery goes to the Tongue. Next, we see
the Facial Artery coming off which more
especially supplies the Inferior Maxillary gland.
These branches come off nearly at right angles,
and all the Salivary glands are supplied
nearly in the same manner. So we are
not to explain the effect of Mercury in producing
a Salivation from the Condensed parts
more readily passing that way, but
from the freedom of the gland, & particularly
sensitivity of the nerves that enter into it.
Then the Artery passes over the Lower jaw
whence it gives the shocks of it, and
can stop Hemorrhages from wounds of

760.
offace. Then tracing this Artery it makes
a serpentine turn about the foramen of the mouth
to allow it to open & shut the mouth readily.
And this may explain the state of the Gums
where the vessels are constricted so as to be
distended very much & then to contract. Next,
these vessels are placed within the Muscles
so that by the action of the Muscles we not
only empty the gland, but can increase the
quantity of secreted liquor in a given time.
Then the Facial Artery communicates with
the Branches of the Internal Carotid at
the corner of the eye; & the External Carotid
have numerous communications about
the Head & Neck, besides the Circle which
the Carotids form. So that after tying
both Carotids, not only all ~~inner~~ ^{inner} ~~secretions~~
functions

46. Functions were performed by means of the
Vertebral arteries, but all the External
by means of those communications. Then
The Vessel is given off from the back part,
and the Temporal before, both w^h communicate
with the Frontal, and the communications
are very large, for as the Vessels are spread
out on the surface of a smooth bone, and
the eye on the side of the Head, there is a
necessity of large trunks in which the blood
may pass with considerable force. And in the
middle of the Head they all communicate,
that of all the Vessels of one side be compressed
the blood may still pass in great quantity
to the other side. So on cutting the
Parotid gland I have seen the Carotid
filled downward in a very few minutes
so that the surgeon was obliged to make a

7/62.

a ligature above. These Arteries are
accompanied with considerable nerves, so
that we are to avoid their situation. This is
the case particularly with the Frontal &
Occipital arteries, and therefore on acct
of the vicinity of the Artery we wd avoid
this Frontal Artery, nor is there much
Reason to suppose that it would be
attended with all the success which Dr
Blair has supposed, and with respect
to the fact, that a bleeding at the Nose
in fever has been often used to relieve the
Head, & prove a Relief to the Disease; the
Blood either happen'd accidentally about
the time, & we are not to consider the
losing a few Drops as the Cause, for if that
were the case we could artfully carry
off

169. off a few at any time. The Temporal
may be opened any where from up upwards
upwards, We can open the Trunk, & readily
compress it; Or We can take one of 4 branches,
and We would prefer the Anterior, where
the Teguments are thinner, and the Nerves
smaller, We feel it therefore better, and open
it with a small degree of danger. With
regard to the Temporal we avoid it,
as the Nerves are remarkably large, and
We do not feel the stroke, the Teguments
being thick and hard, to prevent the
pressure of the Head in a horizontal
posture from stopping the blood. The
Temporal Artery runs off from its root
branches to the Muscles, then the whole
of the External Carotid turns within the Jaw,
when

when it gets the name of the Internal
Maxillary; and splitting into a very
great number of branches, it supplies the
muscles, the substance of the Tongue, the
Palate & side of the Nose; and you ought
to be acquainted with this distribution
as in Diseases of these parts you are led
to the place where blood may be drawn
as in Inflamm^{ns} of the Dura mater, to which
also a branch is sent, and where opening
the Temporal Artery would be of use, or
the taking blood from the Veins in the
case of swelling in Children.

With regard to the Veins, I have nothing
particular to observe, but that on doing
operations on the External Jugular Vein we
should be aware of the thin membrane
over

765. over it, The Surgeon should prepare
for making a deep stroke, and if he
misses the vein with the first stroke, he
may make a second without lifting
his hand. Now, there is a degree of danger
from the accidental course of the Cervical
Artery, some branches of which run
along this Membrane to the Skin —

Lect. 59th

I have shown at the same time the
Structure of the organs of taste, and of smell,
because we often employ them together, and
derive the greatest advantages from doing so.
And we shall begin with considering the
manners of Taste, as being exercised in the
most simple manner, and as the moving
light upon the effect produced in the Nose.
of

of Taste

You have seen very large vessels and Nerves running to the Tongue, and We can give a good reason for this; That the Tongue is to be considered as an Organ conveying very large motions, as well as conveying impressions, and making from its surface sensations, and in all these offices both the Nerves and the Arteries assist in a primary, & secondary way. From the Artery the action is made, which is influenced by the Nerve; and when We perform motion, an impression is made on the Tongue, and the Artery in a secondary way assists the Nerve. Or I mean to add, That as the Heart and the Brain act on each other in a circle, the Brain derives its influence from the Heart, and the Heart again its powers of motion from the Brain, so

467. So in like manner the Arteries & their
Nerves in their progress thro' the body must
=ually, influence each other. So if I stop in a part
the circulation of the blood in one of its extremities
by tying up the Arterial Artery I am not able
to influence the rest thro' that Member in
any dangerous way. While the same effect
made on the other Member in a few minutes
communicate this effect in a way I don't
attempt to define, but rather avoid saying
so, being contented with the fact. Or let us
attend to the Membrane of the Stomach, it can
be made as red as scarlet by an injection
or the number of Vessels seminate than
what is necessary for the separation of the
Mucous; So that we would imagine that
they lay in the way of odorous substances
and we must suppose that in that organ
the

768.

The Arteries go against the Stomach. Let us
next attend a little to the manner in which
We exercise Taste, and determine the way
in which the organ is at the time influenced.
You have seen 3 or 4 kinds of Papillae in
the Tongue; The Posterior organs of perception
are not remarkable for exercising Taste,
tho' We distinguish Taste even in the whole
of the Throat, much better than in other
parts of the body. But Taste is chiefly ex-
ercised in the Anterior part of the Tongue
where We see Papillae which are generally
of a conical shape; & pursuing the Stomach
and Vessels minutely We can trace both
into them. An Injection makes the Papillae
appear better than they do, even in the
Present subject is, They enter in such quantity
as

769. as to increase the bulk considerably. When
causing the sense of Taste, You know that
the substance applied is dissolved in the
Saliva, or in a Watery, Saline, or oily body;
and to make a stronger impression We press
the Tongue against the Palate, causing this
sense as we are apt to say, for if You dip a
Pencil in a scalded oil, and touch the roof of the
Mouth, You are not sensible of a distinct im-
-pression, but the Tongue being rubbed against
the Palate, its sensibility increases of force
of the impression - At the same time we
must believe that the Papillae of the
Tongue are stretched, and become more
sensible; May we also imagine they have
seen the swelling of the Papillae. When
We attend to the parts concerned in the sense,
and

and to the sensibility of the different parts
of the tongue; it is very certain That the 5th
not the 9th Pair, chiefly exercises the function
of Taste; as the 9th branch of the 5th terminates
in the apex of it, which is its most sensible
part. Now, next to taking assistance from
what is done in the organ of Taste, we
may attempt to explain the Manner

of Smell,

And you will observe in the first place,
That a solid body is capable of communicating
smell, finds a ready entrance into our Nose.
The Porous so fitted readily in with the air
and striking against the various parts, ready
to get into the wide cavity of the Nose, it is undisturbed
there; for the air on inspiration first pushes
upwards, and throws the volatile body
against

471. against the Glen Spongiosa, & Almond bone
at the top of the Nose, and every part of the
Candy receives the stroke. And we must
conclude that all the parts receive impression
and that even the Lepthum increases the
surface of the organ of smell, & consequently
its sensibility; just as we see better with
two Eyes and Hear better with two Ears.

The Glen Spongiosa however are the chief
organs which exercise this sense, and of
this we need no other proof than that they
are most exposed, and are the parts which
are chiefly varied in different Animals, and
their extent proportioned to the Acuteness of
Smell. I have already observed the effect
which Animals have upon it, and
we find a great number of them in the
open

open Cavity of the Nose; and tho' We can
not Demonstrate evē Papillæ which swell
in order to increase the Sensibility, as in the
Tongue, yet I apprehend the same thing
nearly happens here, That there is at that
time a greater influx of arterial Blood, and
that the Nerves are rendered more sensible.

The only Difference here is with respect to
the office of the Sinuses; for We are by no
means so follow Authors in supposing that
They extend the Organ of smelling or make
a part of it, or that they serve a variety of pur-
=poses, as the supplying moisture to the
Nose; But That they only render the Voice
louder, and more harmonious; and We
are to consider them as sources of Moisture,
or as serving to increase the acuteness of smell

1749. smell. For let us see what must happen
if all these views are to be admitted.
First, let us consider how far they are proper
for collecting moisture to supply the Nose, or
rather how far such a collection seems to be
necessary. In Children before the sinuses
have begun to form, there is a quantity
of Moisture supplied to the Nose as in
Adults, Besides, Why should this organ
more especially need moisture? It is
erroneous to suppose that because a
current of blood & air passes thro' it, it is in
danger of being dried; for in some of
Inspiration a considerable quantity of
Moisture is carried off, that is supplied
in the Expiration; Besides only attend
to what happens in reality, on alluring
the

The situation of the head, is there any
 evident flow of liquor from the sinuses,
 which should happen from the situation
 of their orifices? Not one drop runs out,
 besides of we admit that supposition, that
 they are sources of liquor, we must suppose
 two very opposite purposes, and the liquor
 contained in the sinuses would counter-
 = act their principle, & only form an office
 that of assisting the voice —

Next, Let us see whether, as might be supposed
 Nature intends by the formation of sinuses
 to add to the organ of smell? If they admit
 odorous bodies, or if we thro' them receive
 any impressions — And first let us
 compare diff^t animals together — The
 variety is not in the sinuses, but in the
 nose

775. Nose, in the Ossa Spongiosa. Do not observe
in the quadruped of which distinguish the
Most accurately, That the Anterior Maxillae
the Sphenoidal, or Almondal Cells are a
bit larger, The Frontal indeed are, but then
these are intended for a different purpose,
of enlarging the front size of the Head, and
for giving room to the several muscles of the
Face & Jaw; and as in many of them
as in Horned Animals, the Skull is much
exposed to injury, a defence is given to
the Brain, and the shock from blows
cannot be so readily communicated
to the Anterior parts. And Comparing these
Animals which smell accurately with
each other, in one the Frontal Sinuses
are

are much larger than in another, while
the *Spongia* very nearly agree. But
further, at what time does the Air enter? Or
are these passages placed so as readily to
admit it? No, every one of the Sinuses has
a winding opening, which is turned away
from the Nostril, the Dust is thrown back-
wards to the Throat, and in the very time
in which we exercise the Sense of Smell with
the greatest acuteness, the Air instead of
entering the Sinuses, goes out of them,
and that for the same reason that it
comes out of a body suppose odorous in a
Bottle, when we smell to it; Thus if I
place a small Phial with an odorous
Pungent body in it, in the Nostril, & make
a full inspiration, the odour is thrown
into

into the nose, the air is rarefied, expanded,
and thrown into the nose. So we
cannot inherit the sense of smell to the
sinuses; nor will you ever find that the
most pungent and fine perfume where
the sinuses are placed. We deceive
ourselves with regard to the throat,
The throat is here coming a truer, but they
never hurt the cheek bone. So the sinuses
only throat, or make the voice more melodious,
which they do in a remarkable manner
and are excellently fitted for —
The voice forms at a certain age, while the
sinuses are in proportion, extending. There
is no doubt a primary law of Nature by
which the bones take a certain shape,
but the extent & increase is continually
going on during life. And take another
fact

1798.
fact, that when the Membrane of the
Nose is thickened in a common Coryza, the
sound of the voice is greatly altered, it, like
a piece of tapestry hung on a wall prevents
the vibrations. and we find them made
of hard bones, the membrane is thinner
than that which lines the Nose, the passage
winding and the opening small. So we
may compare the Maxillary sinus to
a common Drum, there is a great resemblance,
when I make an effort with the voice
the air rushes along the Anterior, and in
speaking a Tremor is communicated to it
which is evidently a very material, and
the only primary purpose it serves.

From the Exposure of the Membrane of
the Nose to the Atmosphere, and to the air
floating in it, they are disposed to many
dis-

779. Disorders, most of which admit of a distance
or alteration by the hand, or instruments
so are properly referred to the surgical part
Lect. 60th

To complete the Anatomy of the Head, it
remains to examine the structure of the Ear,
of which I shall give you a short description.

The External ear is a cartilage covered
with the skin, and from it a passage leads
deep, on the cartilage we find certain
minute muscles, placed, besides those
already known which connect it to the
Head. The side of the passage has a bither
as pointed out upon it, the Ear wax, which
is secreted by small glands that are
placed on the outside of the Membrane.
Next, examining the External passage we find
that the outer part of it only is cartilaginous,
in

in an Adult body, but that the inner
 is made of bone. Now the We speak of
 this being the passage which leads to our
 Ear, yet the bottom of it is quite shut by
 a Membrane of an oval shape which
 shuts the bottom of the Meatus. Still deeper
 than this membrane, we find a regular
 shaped Cavity, large enough to contain
 the point of ones finger, and this being
 covered by a membrane resembling a
 Drum, it is called the Tympanum, or the
 Drum of the Ear, and comparing the
 Membrane to parchment, it is called the
Membrana Tympani. Next, into this
 Cavity we find, coming from the Back
 part, a Cavity large enough at its beginning
 to admit a large quill, but where it
 terminates in the ear it scarcely admits
 a

781. a common sized probe. This passage is
commonly named, after its supposed inventor
Tuba Eustachiana, but it was known to
Aristotle; and we are to use the term of
Meatus internus Auditorius which has been
given to the hole which transmits the seventh
Pair of Nerves, we should give it to this
passage. In the Anatomy I could demonstrate
the end of that passage must be the Ear
which is made of bone, but the other end
opens by maceration, it being cartilage
and ligamentous, on the Internal passage
resembles the External. Now, we find
that this large cavity the Sympharium
has communications with the Cells of
the bones, partly of the Temporal bone, and
its Maxillary process, who communicates
by a winding passage with the Symph
at

At the bottom of the Tympanum we see
in the Malleus two holes named from their
shape oval and round. The oval leads
to a larger cavity, which is called Vestibulum
or we compare it to the door of a house &
the Vestible of it, then from the Vestibulum
passages go off like the rooms of a house.

In all there are seven passages, six of
them are the ends of some circular canals
made of very hard bone, and large enough
to admit the head of pins. The seventh
leads to a more curious organ, like the
shell of a snail, so called Cochlea; and half
of the bottom of the os humerale likewise
at the round hole, or the Cochlea seems
to open into the Vestible, and next into
the cavity of the Tympanum by the
round hole, but in the recent subject these

789. These holes are shut by Membranes; and
next, the Cochlea is divided by a partition
into two parts, the Scala or Hair case.
Now, so far we do not observe any immediate
connections between the Deaf parts, and the
more External; but next, the Membranes of
the Tympanum & of the Oval hole are tied
together by a chain of bones which are
named from their shapes, Malleus, Incus,
Orbitularis & Malp; and these small bones
are not only articulated in the common
manner, but we shall find muscles con=
=nected to them.

Now, the last internal part of the Ear, the
very bottom of it, the Cochlea, Semi-circular
Canals, and Vestibule, are lined with
the Cortis mollis; the Figuration, one of the
latest, and most accurate Writers on
this

This subject denies this; but it seems ^{784.}
to form the Membrane Bell of Dr. Locke
& semi-circular canals, as much as the
Retina appears to be the continuation
of the Optic Nerve
Sept. 6. 1808

Let us next determine the use of each part, and
more particularly, the way in which sound
makes its impression on the Nerve, The Cortis
Mollis at the bottom of the Ear. We can go no
further in explaining any sense, so in the
Eye we can only show the manner in which
the picture is formed, without knowing the
way in which our Mind perceives a picture
of sound

You already know the way in which we
form the voice, that the Ligaments and the
parts of the Larynx tremble, communicate
their

785. This tremor to the air, hence we hear by
the tremor which the air communicates to the
Porus molles. And as in the eye the light is
collected to form a picture, so here the tremor is
concentrated as it were, or the structure is such
as to impress the sense more forcibly than if you
were to suppose the inner side of the cochlear
or semicircular canals placed on the surface
of the body. Before we trace the effect of sound
on the ear, you will attend to the use of the
Wax, and of the Hairs on the external passage.
The Hairs are evidently intended to keep
Insects from entering, the Wax is for a similar
purpose, and likewise being an oily as it
prevents the Tindur Membr lining the
Cartilage from being too much dried, and
which had it not been for this would have
required to have been made thicker; and the

786.
The thinness is of service that the impression
of the sound may fall better on the part most
capable of reacting or vibrating the cartilage.
But the Wax is evidently of no further use in
our hearing.

Now next let us see the means used to collect
the sound, or to render it louder. First, The
External ear being a hollow so large, than
the passage, the sound falling upon it, is
thrown with force into the passage, for a greater
quantity of sound perhaps strikes the ear
from the flatness of our head, which is not
merely calculated for enlarging the sphere of
vision, and from preventing the External
ear from being exposed to accidents, but from
the flat side the sound is thrown off upon
the External ear with more advantage.
Quadrupes use the External ear for the

737. The collection of sound, they raise it, when
raised by sound, and turn the cone of its
exactly toward the sound, preparing a large
motion of its and Birds which seemingly
labour under the same disadvantages with
respect to hearing with us, When the sun to
turn one ear toward a sounding body in
reality turn both. Nor find that on pouring
Liquor silver into one ear, it goes under the
Brain into the other, or there is a passage by
which they communicate. The Shape of the
Ear in the Human body is much less favorable
for receiving the whole impression than in
many Quadrupeds, and is by no means
so equisidely formed that no ray which enters
it should get out again. Perhaps there might
be a shape better calculated for collecting
sound, as the Plain Cone, in fact, in the
case

case of Persons who are dull of hearing. We
 conceive a machine which collects the sound
 better than one of the shape of the Ear. Yet more
 enters than you are aware of, the passages
 are winding, the prominences turn the
 sound from the diff angles towards y Meatus,
 and perhaps the winding course may
 add to the force; Just as in a winding passage
 bounded by walls, in a building, the sound
 is louder than if it were straight. So in the
 Palace here, as you go to the Sleepy Park, there
 is a winding passage, and the sound is
 much louder in it than in any other
 straight passage of the same length.

The sound is thrown from one part of the
 Ear into another, and the force is increased,
 when the sound gets to the cochlea it is
 confus'd by the Tragus and Antitragus, and

789. and drawn by them into the Meatus; We
need no other proof of this than to observe, that
by pressing the hand on the Tragus inward &
a very little, we can shut the Ear-Meatus.
Next, a tension is given ^{by} ~~on~~ the Muscles on the
Cartilage; & this too is the principle purpose of
these muscles which are connected together,
as for example, such a power can then act to
alter much the situation of, External ear,
Who indeed some have a remarkable motion
of it, as a Gentleman who attended here last
Winter and I am told the celebrated Albinus
had the same power. And this Gentleman
could not only at pleasure raise the Ear, but
he had frequently observed that as soon as a
sound affected him the Ear was in motion.
And I think we can't doubt of this, from ob-
-serving Quadrupeds whose ear starts up by

by its muscles, gets the proper direction ^{790.}
and tension when affected by a sound, and
we may suppose that in Motos, besides the
proper tension, there is in all a degree of motion,
or the power either to push or pull further than we
are aware of, or the contractile power cannot
even to our skin, which in every animal
is affected by Cold and Heat more than it is
in the Dead body. If we wanted any thing
further to confirm the use of the External
Ear we might observe, that whereby accident
it has been lost, a very considerable Dullness
of Hearing has been occasioned.

Next, we pursue the Sound thro' the External
passage, which is form'd of a firm and Elastic
Cartilage, & of a Bone which is hard and fitted for
Memor, and where they are join'd a turn is
made, or the Canal is not absolutely straight, but

791. But it is so little from the straight line that we
may see to the very bottom of the Matus, to examine
the state of the Membrane of the Drum by pulling
the back part of the Ear. As the drum the sound
is reverberated, and at the bottom of the passage
from the Concavity of the Membrane, it is thrown
from the circumference to the middle, the
membrane being drawn in by the Malleus,
and the chain of bones then has a greater advantage
= age than if the Membrane had been perfectly
flat. A solid body would have rushed down
here along the sides to the middle, & sound
will do the same, so we may say that it is
Concentrated upon the Membrana Tympani
We trace the sound further, and aided by
the chain of bones & Muscles in a line from
the Membrane of the Drum towards the
middle

Thus as the bottom. Suppose that connection
 to be made only by the Bones wth their ligaments
 a strong impression would be propagated to wth
 the Stone; but we find that these bones have
 evident muscles which serve to stretch them;
 the Muscles of the Malleus draws the Membrane
 of the Drum inwards, and at the same time
 pulls the Malleus in the same direction, while
 the Muscles of the Staples pulls the Head of the
 bone outwards; so that two Muscles are Anta-
 -gonists. And whilst the Membrane is affected
 the Chain of bones are also, and hence a more
 forcible impression given. And as we must
 admit that the External muscles are influenced
 by the Sound, why should we deny that
 the same happens to the Internal muscles
 that these act in the manner which is most
 fit

793. It may, that perhaps they give the chain of
Bones a vibration corresponding to the sound.
Thus if the place two Na-pouches of stretched in
the same manner, both in tune near to each
other, the corresponding chord of the other will
vibrate, or it will be more affected than any other
chord of the instrument. So there may be a
correspondence between the sound we mean
to listen to, and the vibration of the Bones, or that
we do not act with these muscles merely because
a sound is here, & we do not hear it well, but
act so as to make the impressions much
more exact —

At first sight one would conceive this to be the
only way of impression, the drum passing
thro' the chain of bones, but a little attention
soon convinces us of the contrary. If this
were true, what is the use of the Drummers
Beats —

794.

Rotundum and other half of the Cochleari? Now
is the impression made to these? We must therefore
must admit or suppose that altho the Chain of
Bones were wanting, still we sh^d distinguish
sounds. And in fact this has been observed, there
are several instances where the bones have
been destroyed by an ulceration from the
Cochlear Meatus, and yet the person for a considerable
time could distinguish sounds. Experiments
upon this subject have been made, but they
have not been sufficiently prosecuted so as to
speak with precision concerning the effect.
But we know from this, and accidental
observations, that a tumor is most communicated
from the cavity of the Tympanum to the ear
within it, and from thence to the nerves which
eye still depend. Now, we see the Cochlearian
tube added for the conveyance of air, which
is

195. is certainly its primary purpose. We cannot
say, with many Authors that it is necessary to
have a tube to let out the mucus produced from
the condensation of the liquor that is exhaled
into this cavity; for there is no such communication
from other cavities as the Pleura, Peritoneum &c.
So it seems to make a change of air, for though a
quantity were originally lodged here it would
soon grow off, and perhaps it being heated a
little by passing just thro' the nose makes it
less ready to injure the deep parts. At first it
might appear to be very inconsistent,
in that the sputum is first collected from
the trachea, while from the size of the Symphium,
it is a fine office, & the mucus from appearing
lost. But you will reflect that the cavity of
the Symphium is very warm, that
it

it consists of hard bone covered with a thin 796.
membrane, that it communicates with the Cells
of the Nasal process; and join to that what has
been alleged of the sinuses of the Nose, that their
primary use is to render the Voice louder and
more harmonious, and We may suppose the
impulsion here to have a similar effect, by the
passages vibrating the impulsion is made
stronger. Or We may compare this instrument
better to a Drum than any part of the Nose, the
Membrane resembling the Parchment, and the
Eustachian tube the hole for it. We see then
impulsion communicated in two Ways, Now
to these Authors add a third mode of impulsion,
where they suppose that an effect even equal
to either of the other two, is the impulsion
thro' the Eustachian tube, which they suppose
com=

297. communicates the impression wth great advantage
from its structure and shape, and that is, mouth
if it is placed in our Throat to receive through the
Nose sound from without, and I shall now to
receive the sound of our own voice from the nose,
And we could not well doubt of this without an
Experiment, And I know very certainly that the
Effect in this way is so considerable that we
may entirely overlook it. If you shut the
External passage, and listen to a sounding body,
as an Alarm bell, placed upon a Cushion, and
sealed upon another yourself, to prevent the
vibration of the whole body, tho' the sound be so
loud as to be offensive to the Ear when open, yet
on shutting the Ear you are scarcely sensible
of the sound; Or put a Watch into your mouth
not touching the Teeth, and you will not hear
it

its strokes. So those who have imagined a ^{798.}
Order & impression to be communicated in this way
have been deceived merely by the probability of the
thing, or by the inaccuracy of an Experiment
mentioned by Valerius, as when there was an
Uleer in the Throat, and He introduced a tube into
the Eustachian tube to prevent the sides from
joining together, and as soon as it was put in,
the Patient lost his hearing. But it does not at all
appear from the History of this Case that He
stopped the passage on the other side at the same
time, so He could not Judge exactly, besides
suppose that we do receive an impression
in that manner, how came it that the
impression was not propagated to the Cavities
of the Ear, for the air could not become so flat as

799. at once; so the Tumor should have been commenced
from the external ear for a length of time.

There is a Fourth way of distinguishing sounds
viz. By the Tumor communicated to the whole
body, & particularly affecting the Periostomollis, for
we do not by any tumor of the body, affect any
of the other senses; if a considerable stroke is
given to the eye, we see like flashes of fire or
light; but from sound we do not see these,
the Periostomollis is only affected, it being best
fitted for such an impression. In this way the
impression is very Considerable, and often Persons
who have lost the external part of this Organ,
or where they were quite spoiled by disease,
in this way distinguish sounds. So if you
strike a fork till it trembles and touch the
teeth

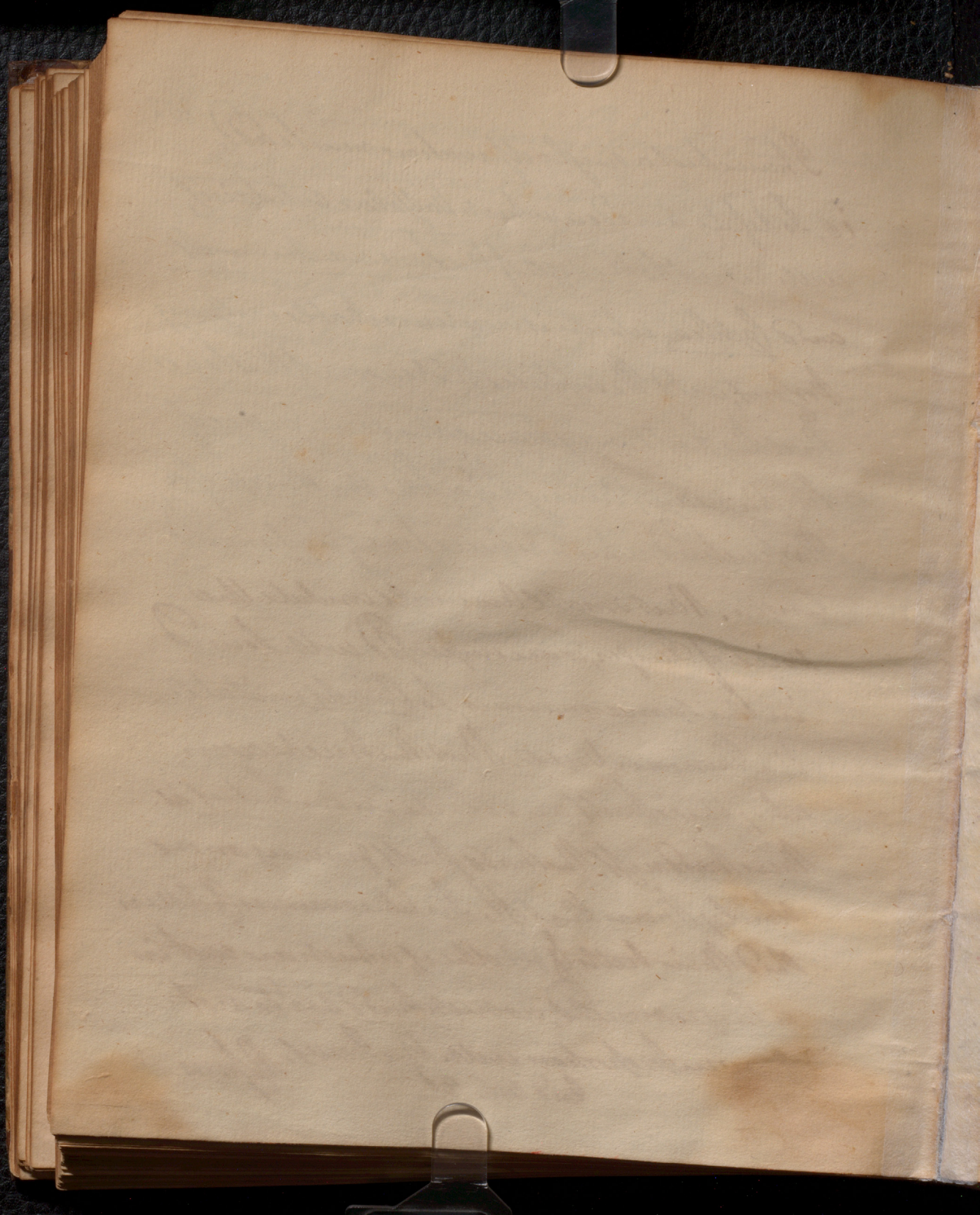
teeth with it, you hear a sound; and this is
 is not owing to any communication of Nerves
 as from the Maxillary Nerves joining the Cortis
 Dura, and the Chorda Tympani passing through
 the Ear, for if the Middle the under Jaw, the sound
 is not so loud, so it is owing to the connected
 bones communicating the Motion. Or Take a bit
 of Hard wood, and place it against the upper
 Jaw of a Person who is Dull of hearing, and you
 may converse with him taking hold of the
 other end of the piece of wood between your
 Teeth, while you pronounce the words, and
 this very method has of late been recommend
 by a German Writer.

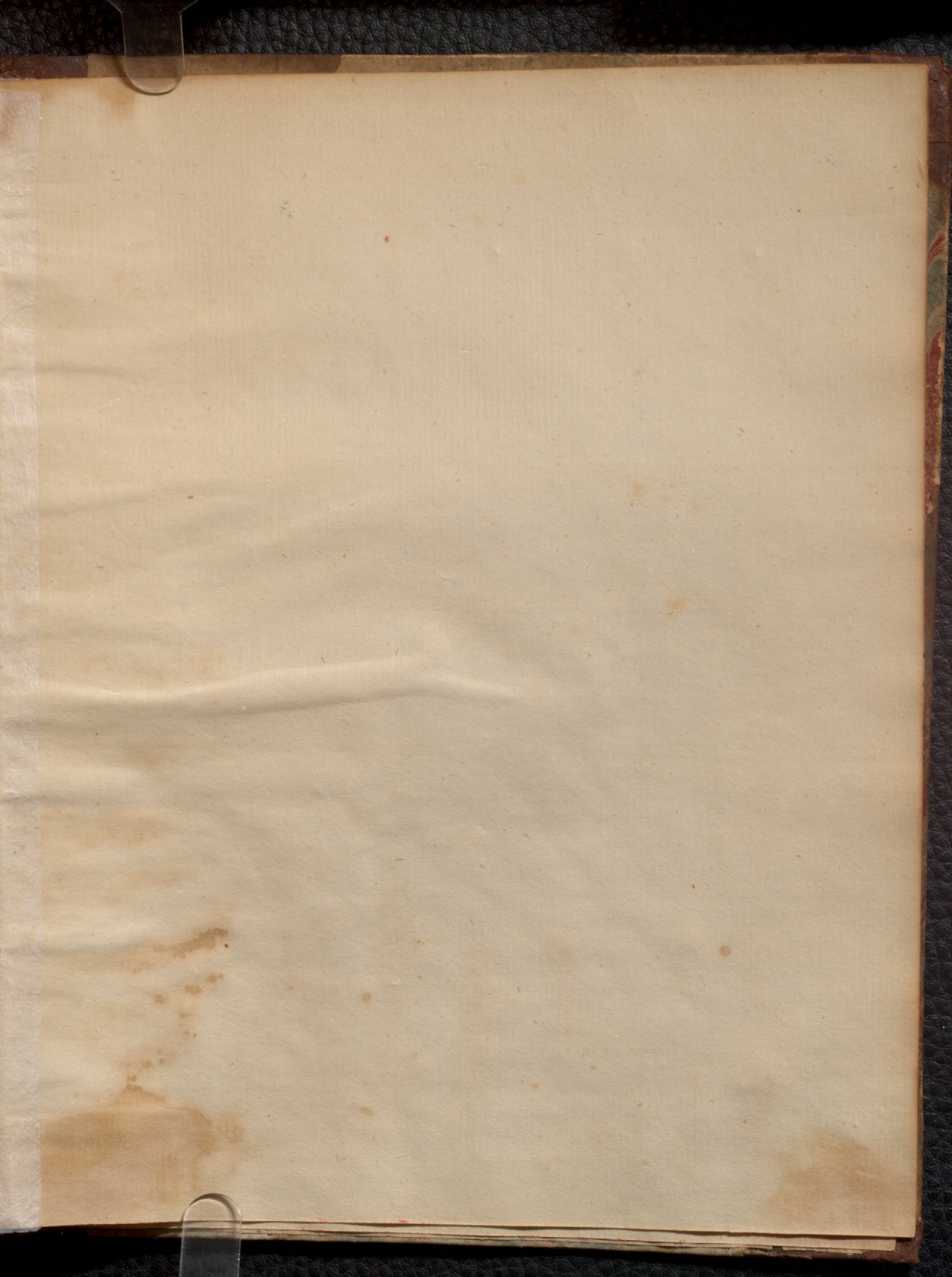
The only point remaining then is, to determine
 How the impression is conveyed so as to touch
 the Cortis Mollis— Whether an insect suppose
 that

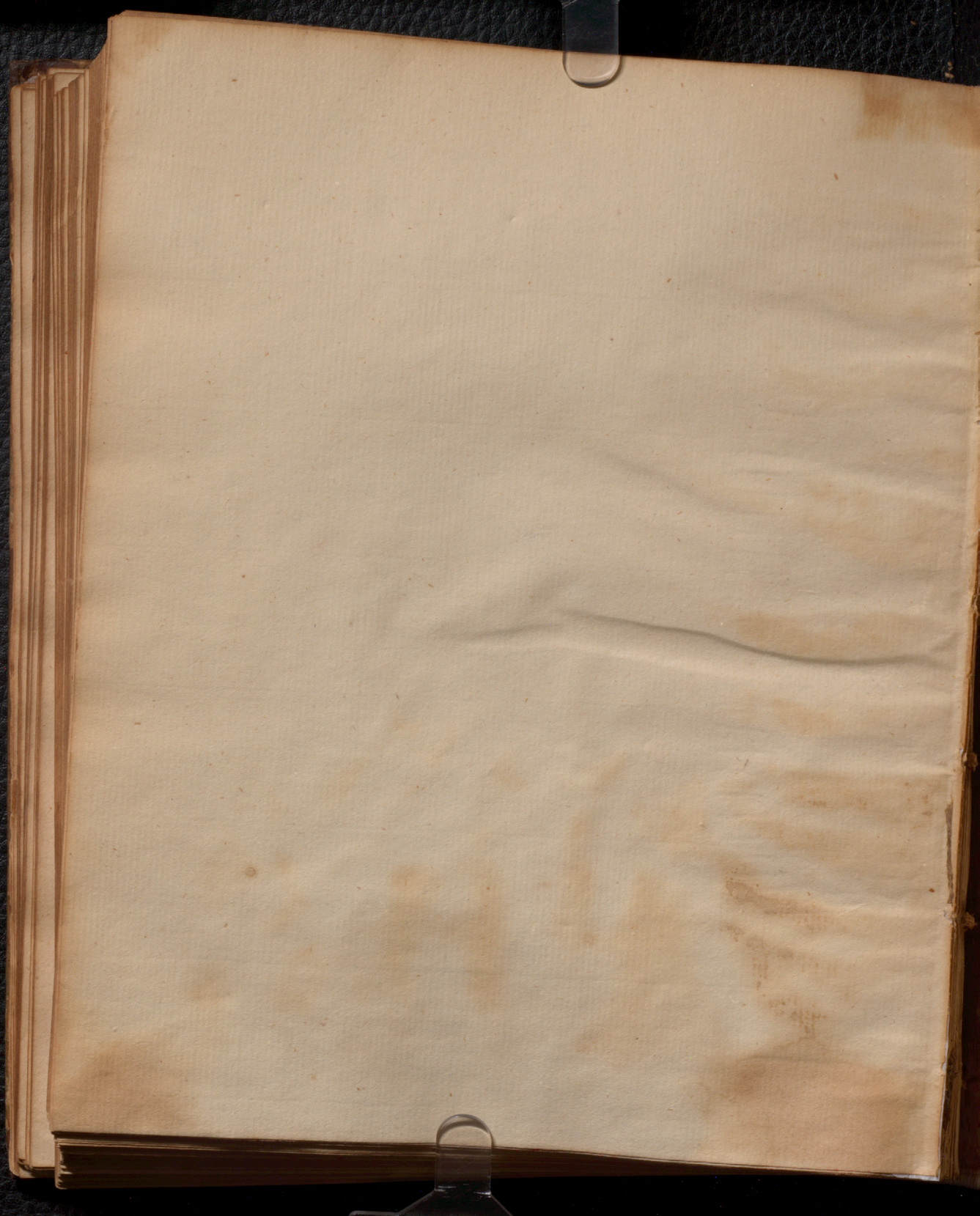
801. That the Tumor is covered from the Membrane
shutting the oval and round holes, by the Air
to the Tumor, or are the Arteries, & venous canals
filled with a fluid? Columbus an
Italian Writer affirms that there is a watery
liquor contained. Perhaps his experiments are
not very accurate, and He seems especially to
conclude this, from the difficulty, nay, impossibility
of air getting in. But I shall prove afterwards
that air may be sucked from the lips of
Animals. However this opinion seems to be
the most probable, and we know that Water
is capable of communicating the sound. So if we
surround a bell with air in it, in water, and
ring it, you will hear the sound thro' the
Water, or when your head is covered with
Water, you will be still liable to distinguish
Sound.

I

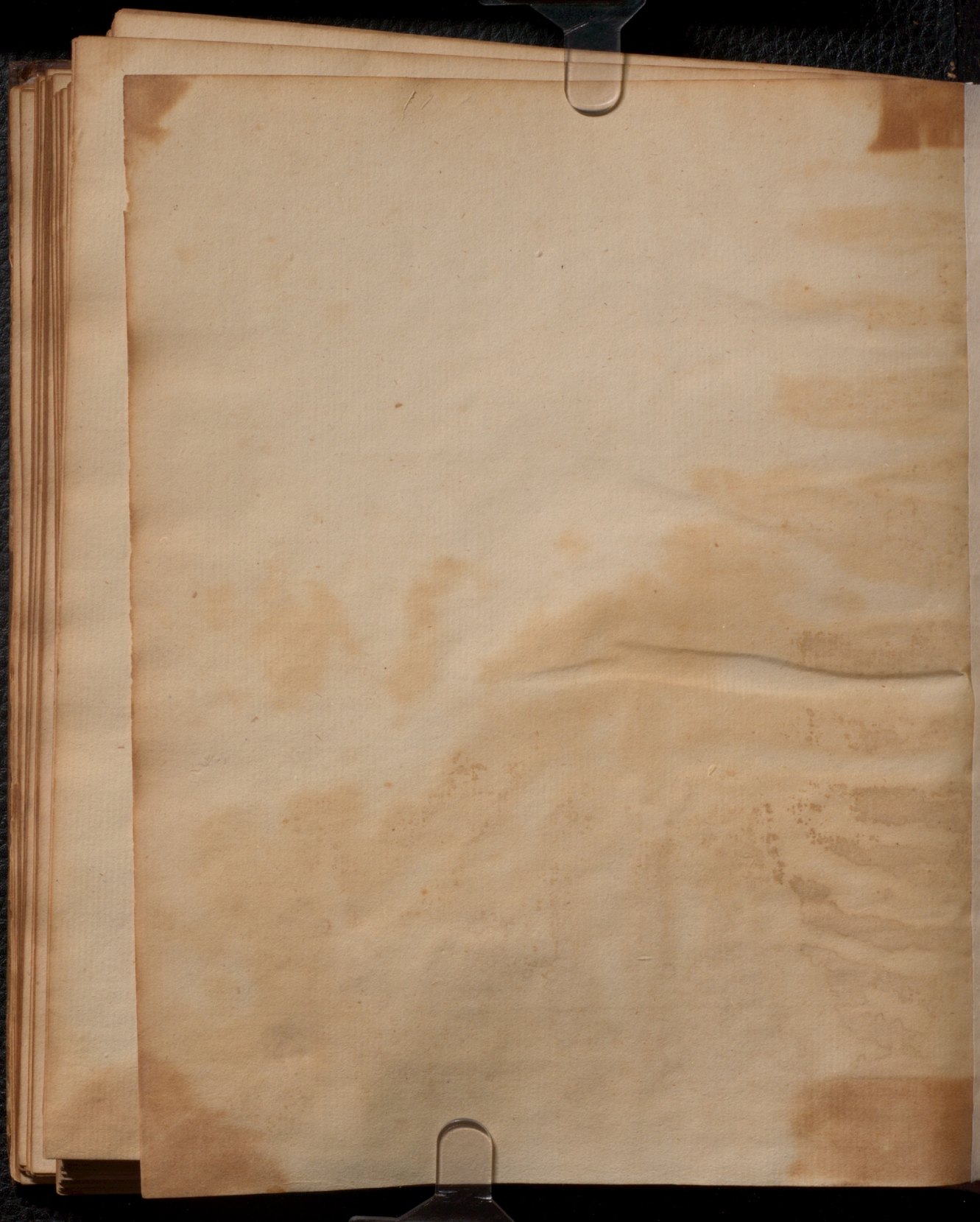
I have but a single observation more to add, 802.
ie, To refute an idea which Buffon entertains,
with respect to the size of the Amur canals
and Gobies, which is very remarkable in young
persons, and He supposes the reason of this to be
That the parts may have the same degree of
length nearly during life; like the wings of a
Warphond, which require to be of a determin'd
length. But small animals imitate the
voice of danger, or are impress'd with sound
in the same manner, so Parrots imitate
the Human voice. But the true reason
why these parts are so large in the Infant is
their hardness; the hard parts growing more
slowly than the soft. In like manner Children
shed their teeth, & set others, which are cast in
a larger mould, as such hard parts do not
grow in proportion with the Soft. Byron
End Vol. 2d











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